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THE GRAMMAR

OF

SOUTH INDIAN (Karnatic) MUSIC

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BY

C. SUBRAHMANYA AYYAR, B.A.,

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OPINIONS

1. **Mr. T. V. Subba Rao**, B.A.,B.L., Chairman of the Board of Studies, Indian Music, the Madras and the Andhra Universities, and Honorary Reader in Music, the University of Madras, writes:

* * *

"The author is himself a violinist of considerable standing.

* * * He has further conducted experiments with scientific instruments in regard to tonal values of notes used in South Indian Music. * *

The question of srutis, which is perhaps the most discussed of all themes in music, rightly engages the best part of his attention. I have therefore much pleasure in commending the book to those, who care to know the fundamentals about the theory and practice of South Indian Music."

2. **Mr. P. Sambamoorthy**, B.A., B.L., Head of the Department of Indian Music, the University of Madras, writes:

* * *

"**Mr. C. S. Ayyar** has done a valuable piece of work by the publication of a book on the subject of srutis. clearly explaining the principles underlying the scheme, * * * The book contains the fruits of the author's researches in this subject for a number of years, and is well worth a careful study by every scholar of music."

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BY

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WITH
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FOREWORD.

In these days of revival of general interest in South Indian music, the fundamental principles of Karnatic music are more and more widely studied and discussed. The modern mind is not satisfied with the traditional method of exposition of the intricacies of music. A more rational and scientific approach to the subject is increasingly in demand. The author of this book has been confronted with this problem for many years, and has made a systematic and scientific study of one of the most important aspects of Indian Music, namely the origin and interpretation of the twenty-two srutis. He has made a thorough study of the subject by using a long sonometer and standard tuning forks. He has tried *objectively* to understand the subtleties of South Indian Ragas, the Raga Bhavas and Gamakas. He published a series of articles in "The Hindu" in 1928 and the matter was then widely discussed.

The conclusions arrived at as a result of a critical study and observation extending over a period of twelve years, have been embodied in this book—The grammar of South Indian (Karnatic) Music.

I give below two of the interesting conclusions put forward by the author: (1) Some of the twenty-two srutis based on Sa Pa and Sa Ma-bases (the traditional

method) are too complex for the human voice to reach directly. The musical notes of values 7/6, 7/5 and 7/4 are recognisable in Karnatic music, but cannot be obtained on the above traditional method. Hence the traditional method of arriving at the twenty-two srutis has to be discarded. (2) The human voice when it goes over a wide range in a melody, steps on generally, from one note to another, in simple musical intervals like 6/5, 5/4, 4/3, and 3/2. Musical intervals of the voice cannot be such complex ratios like 75/64 (interval between ri and Ga of Mayamalava Gaula). The author therefore states that the voice first reaches Ma and then drops from Ma to Ga. As a violinist, he asserts, that Ma is touched before lifting the finger to Ga. This fundamental hypothesis has been used throughout in determining the frequencies and the values of the notes of the important ragas.

The thesis thus attempted by the author is of deep interest though radical, being quite contrary to the traditional interpretation of the old texts on music, which are not always unanimous. Anyway, such a disturbing proposition must set all thinking artists to a great deal of activity and before long, I hope its truth will be established beyond doubt.

9—8—1939,
Andhra University,
Waltair.

V. APPA RAO.

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1. The Tambura
2. A Lady playing on the Vina

PREFACE.

My reason in bringing out this book is that I have been harping on the subject of *Srutis* or microtones since the year 1928, and lecturing to interested audiences* in Madras, Calcutta, Bombay and Allahabad. I feel the paramount necessity for the correct perception of microtones by all artists, vocalists and instrumentalists alike, for their clear exposition of the Rāga *Bhava*. I place this book before all learners to popularise the idea of Śrutis so that these mathematical conceptions may help them and lead *as in my case* to a better exhibition of the art itself. The book will certainly be of use to students of music, who have gained sufficient understanding to be able to decipher any melodic music by the twelve rough pitches in the octave or *Sthăyi*. It may also interest the general reader, who may perhaps find in this book, a statement of the evolution of our music from simpler melodic pieces to the present art-stage.

The present thesis purposely does *not* refer to the more ancient theoretical works on music in Sanskrit. It is based entirely on my musical experience with a little knowledge of modern Physics, and of musical comparisons and unisons suggested by a musical ear. I have also added two Chapters of general musical interest.

---

*(i) Journal of the Music Academy, Madras, Vol. II, 1931.

(ii) Lecture on Music and Numbers on 17-1-1933 reproduced in the Calcutta Review for May 1933.

(iii) Proceedings, Allahabad University Conference of the year 1934.

PRELIMINARY NOTE.

The book is intended to be read throughout India by both Hindustani and South Indian artistes, and by Europeans, who have evinced interest in Indian music, both Hindustani and Carnatic. Hence, complexity of description is unavoidable. The following notation and symbols will be used in transcribing the music, *i.e.*, when the ascending (Arōha) and descending (Avarōha) notes (Swaras) are given for any raga.

Notes. The signs,

C d D e E F f G a A b B Ċ will be used, the *capitals* for the *white* keys of a Piano and the *small* letters for the *black* keys, *i.e.*, flats in the case of D E A and B, and sharp in the case of F, for the twelve frets in the octave (Sthayi) to be represented in Indian notation by the signs.

Swaras of	Sa	ri	Ri	ga	Ga	Ma	ma	Pa	da	Da	ni	Ni	Ṡa
of the middle		or	or							or	or		
octave.		(ga)	(Ri)							(ni)	(Da)		

The symbols in brackets will be explained later.

It is presumed that the fundamental pitch, which the singer adopts, will be represented by C, or Sa in the notation, though it may not be intrinsically C of 256 vibrations per second. Notes of the higher octave will have a dot above, and the notes of the lower octave a dot below them. The elongation of the time of the notes will be represented by commas (, , ,) one, two, or three as the case may be, to represent the elongation by one or more measures, of the note subsequent to which it is put. A

semi colon (;) is occasionally used to represent two commas of length of time.

The music will be written by the several time measures consisting of say 8, 7, 6, or 5 units as the case may be, and to denote the time measures, the letters 1, 2, 3, 4, 5, 6, 7, 8 will be written above the 'Sarigama' notation, each phrase being separated by vertical lines thus||. A single dash-- -above the 'Sarigama' notation will represent that the notes will run in half time and two dashes = will denote that they will run in a quarter of the unit time. There is no need for further elaboration, as melodies generally run from (lower) Ṃa or P̣a, and pass through a middle octave to (higher) Ṗa. Thus Sa, $\overline{\text{Ri Sa}}$ Sa will represent 4 units of time.

N.B.—I have purposely used Da or da to represent 'Dhaivata'. The South Indian has long since practically dropped the sound 'Dha' in swara singing and substituted for it the unaspirated Da, excepting on a few occasions in ragas Sankarabharana or Kalyani and only very rarely in Kambodhi. In all other ragas, the sound 'Da' is used generally, including the flat variety, which I have denoted by the small 'da'.

The corresponding names for the South Indian (Carnatic) and "Hindustani" notes in *common parlance* are given.

Carnatic.	Sign.	Hindustani.
Swaras or notes.		Follows Bilawal scale or the Diatonic scale for Suddha notes.
1. Shadja.	Sa	Shadja.
2. Suddha riṣabha.	ri	Komal riṣabha.
3. Chatusruti Riṣabha	Ri	
or		Suddha Riṣabha.
Suddha gāndhāra.	(ga)	
4. Sādhāraṇa gāndhāra	ga	
or		Komal gāndhāra.
Shadasruti Riṣabha.	(Ri)	
5. Antara Gāndhāra.	Ga*	Suddha Gāndhāra.
6. Suddha Madhyama.	Ma	Suddha Madhyama.
7. Prati madhyama.	ma	Tivra madhyama.
8. Pañcama.	Pa	Pañcama.
9. Suddha dhaivata.	da	Komal dhaivata.
10. Chatusruti Dhaivata	Da	
or		Suddha Dhaivata.
Suddha niṣhada.	(ni)	
11. Kaisika niṣhada.	ni	Komal niṣhada.
Shadsruti Dhaivata.	(Da)	
12. Kākali Niṣhāda.	Ni	Suddha Niṣāda.
13. Tara Shadja.	Ṡa	Tara Shadja.

*I prefer to call this swara *Antargata* Gāndhāra (meaning that which merges with Sa and Pa.) This note of frequency 5/4 is also heard when the four strings of the Tambura are struck. The strings are tuned thus, (Lower) Ṣa, Sa, Sa, (Lower) P̣a, with frequencies 1/2, 1, 1, 3/4 counting from the position next to the singer. Vide Picture 1, and thus 5/4 being the sum of the frequencies

of the first and the last strings is heard. The strings are, however, twanged Pa Sa Sa Ṣa *i.e.*, in the reverse order.

(Occasionally the Tambura is also tuned as (lower) Ṣa, Sa Ṣa and (lower) Ṃa. This is called Madhyama Sruti. The frequencies then are 1/2, 1, 1, 2/3. What was originally Sa of the singer becomes *Pa*, as it were, *of the music*. The relative frequencies are thus 3/4, 3/2 3/2, 1.) Note also the *jeeva dhara*, the silk string underneath the wires and over the bridge to make the tone resonant, when the point of contact of the string with the bridge is properly adjusted.

CHAPTER I.

WESTERN INTERPRETERS AND OUR MUSIC.

It will be clear to any one, even to a beginner, who starts from the 'Gītams,' that if one just plays the 'swaras' (notes) given against the *Sāhitya* or the words of the melody, that there is only just an attempt at reproducing the melody; and the melody does not sufficiently resemble what the voice produces. Even a beginner, practising on an instrument (the Vina or the violin), learns before even the first few lessons are over, an idea of *Swarasthanas* (and their purpose) in the octave obtaining on the frets of the Vīna, or the twelve *positions* of the fingers on the violin.

For an understanding of the subject, it is necessary that certain fundamental physical facts should be appreciated. The science of Physics tells us that certain definite recognized pitches are heard at certain aliquot parts of strings. Even from the time of Plato, it was known that the sounds, which emerged at divisions of the strings in simple aliquot parts, were certain definite musical notes, and from these facts Physicists have obtained the relative frequency ratios. For example, it may be stated that if the frequency of a whole vibrating string is 1, the relative frequencies of the smaller portions of the string will be in the *inverse* ratio of the *vibrating* portions of the string, provided the tension is constant.

The following table will show what relative frequencies are obtained from what aliquot parts of each string.

TABLE I.

Name of string.	Portion damped from one end.	Portion of the vibrating string.	Rel. frequency.	Name of Note	English name.
1	2	3	4	5	6
Sa	nil	Whole	1	Shadja	Tonic.
do	1/2	1/2	2	Higher Sa	The octave.
do	1/3	2/3	3/2	Pañcama	True fifth.
do	1/4	3/4	4/3	Suddha Madhyama	True fourth
do	1/5	4/5	5/4	Antargata Gāndhāra	Major third
do	1/6	5/6	6/5	Sādhāraṇa gāndhāra.	Minor third.
do	2/5	3/5	5/3	*Trisruti* Dhaivata. though known generally as chatusruti Dhaivata.	Major Sixth.

Of course, the tension of the string is presumed to be constant. In actual play, conditions differ, and we produce notes by pressing up to the finger board and the exact lengths may not be the same.

It may interest the reader to know that the first few frets which are placed on the Sa string of the Vina [i.e., the string closest to the artist, or the fundamental, i.e. the

commencement of the middle octave for the human voice], *are really those which produce the higher Sa, Panchama Suddha Madhyama, Antargata Gandhara and the Trisruti Dhaivata.*

The Vina of South India (Vide Picture 2) has seven strings, four for playing the music, two of brass and two of steel. It has also three strings below for twanging with the little finger for the purposes of the drone and for rhythm. The frets are placed underneath the playing strings.

TABLE II.

Name of string.	Portion damped from head.	Portion of the string vibrating.	Rel. frequency.	Name of Note.
1	2	3	4	5
Pa	Nil	Whole	3/2	Panchama (Dominant.)
,,	1/2	1/2	3	Higher Panchama.
,,	1/3	2/3	9/4	Chatusruti Rishabha (Ri).
,,	1/4	3/4	2	Higher Shadja.
,,	1/5	4/5	15/8	Kakali Nishadha (Ni)
,,	1/6	5/6	9/5	Kaisika nishadha(harmonic on Pa string).
,,	2/5	3/5	5/2	Antargata Gāndhara.

It will be seen that the ratios in column 4 of Table II are 3/2 times those in the same column of Table I.

Really on the Vina, the 2nd string behind is lower Pa, and therefore, the frequencies will be just one half of those mentioned in the examples, *i.e.*, of the lower octave. They will be really true of the strings of the violin, tuned Sa and Pa.

It will also be seen that the very same frets which are first placed on the Sa string of the Vina, will give the corresponding positions of the notes obtained on the Pa string.

Now let me introduce to the reader the idea of the English diatonic Major scale. It is really the Sankara-bharna positions on the Sa and Pa strings. The seven notes are obtained by the Sa, Ga and Pa relationship 1, 5/4, 3/2, from Sa, Ma and Pa, having frequency values 1, 4/3, 3/2. Only Ri has to be taken down to the lower octave. Physicists have fixed the relative frequencies of Sa Ri Ga Ma Pa Da Ni Ṡa at the relative values of 24, 27, 30, 32, 36, 40, 45, 48 or in fractional ratios 1, 9/8, 5/4, 4/3, 3/2, 5/3, 15/8, and 2. These have already been obtained at certain aliquot parts of the strings stated above. If we just turn our attention to the Harmonium or the Piano, and take only the white keys, we have seven keys in the octave. If I play only on the white keys taking the first C as the fundamental, (or *Adhara* Sruti) I get only Sankarābharana; but if I change the fundamental, and *keep on resounding the second key* for instance to get the effect of the drone on the ear, and play on the white keys only, a different raga effect is produced.

on the ear; similarly, if I keep the fundamental as the third white key, or the fourth white key, and so on, we get different melody types. Thus it has long been recognized from ancient times that seven melodic types are produced, and these can be mathematically evaluated as below.

See Figure 1. Which gives the Sankarabharana.

MELODIC MUSIC AND NUMBERS.

Fig. 1.

Here C (Sa) is fundamental. Diatonic Major Scale:— Sankarabharana. Melakarta 29.

	C	D	E	F	G	A	B	Ċ
	24,	27,	30,	32,	36,	40,	45,	48,
Relative frequencies.	1,	9/8	5/4	4/3	3/2	5/3	15/8	2
Intervals between *Swaras*.	9/8	10/9	16/15	9/8	10/9	9/8	16/15	

NOTES OF HIGHER OCTAVE.

Ċ	Ḋ	Ė	Ḟ	Ġ	Ȧ	Ḃ	C̈
48,	54,	60,	64,	72,	80,	90,	96,

Intervals.		
	Major tone	9/8
	Minor tone	10/9
	Semi tone	16/15
	Small semi tone	25/24

I introduce here three names, the major tone, the minor tone, and the semi tone, which have relative frequencies 9/8, 10/9, 16/15. There is mention of another interval, the small semi tone, which has a

frequency 25/24 though it is not at present relevant to the Sankarabharna scale. If the D or Ri is set as the fundamental, I get roughly the Kharaharapriya, Fig. 2. If the E or the Antargata Gandhara is set as the fundamental, I get roughly Hanumathodi, *see* Fig. 3. If F or Ma is set as the fundamental, I get nearly the Kalyani, *see* Fig. 4. If G or Pa is set as the fundamental, I get the Harikambodhi, *see* Fig. 5. If A or Trisruti Dhaivata is set as the fundamental, I get Nata Bhairavi, *see* Fig. 6. These are the six Grecian scales. If B or Kakali Nishada is set as the fundamental I get practically Hanumathodi, except for the fifth, *see* Fig. 7. This also accords with the oral tradition that there were originally seven ragas and that one of them was discarded.

Fig. 2.

Here D or Ri is fundamental. Kharaharapriya; (Melakarta 22) Dorian * Mode.

	D	E	F	G	A	B	Ċ	Ḋ
	27,	30,	32,	36,	40,	45,	48,	54
Relative frequency.	1,	10/9,	32/27*,	4/3	40/27†,	5/3,	16/9,	2
Intervals..		10/9	16/15	9/8	10/9	9/8	16/15	9/8

* Does the voice produce the note of frequency 32/27 directly and elongate it straight?

† Here out of tune from true fifth 3/2.

We have to raise the fifth note slightly, to 3/2 in which case the fourth interval would become 9/8 and the fifth interval 10/9.

---

* The names of the Grecian scales have been taken from Popley's "Music of India": they differ from those given in Helmholtz.

Fig. 3.

Here E or Ga is the fundamental. May possibly be, Hanumathodi (Melakarta 8). Bhairavi in Hindustani. Black note scale. (Phrygian).

	E	F	G	A	B	Ċ	Ḋ	Ė
	30,	32,	36,	40,	45,	48,	54,	60
Relative frequency.	1,	16/15,	6/5,	4/3,	3/2,	8/5,	9/5,	2
Intervals ..	16/15	9/8	10/9	9/8	16/15	9/8	10/9	

Fig. 4.

Here F or Ma is the fundamental. Kalyani (Melakartā 65). Lydian authentic mode.

	F	G	A	B	Ċ	Ḋ	Ė	Ḟ
	32,	36,	40,	45,	48,	54,	60,	64
Relative frequency.	1,	9/8,	5/4,	45/32*,	3/2,	27/16*	15/8,	2
Intervals ..	9/8	10/9	9/8	16/15	9/8	10/9	16/15	

* Can the voice produce these frequencies directly?

Fig. 5.

Here G or Pa is the fundamental. Harikambodi. Hypo-Lydian Plagal mode. Melakartā 28.

	G	A	B	Ċ	Ḋ	Ė	Ḟ	Ġ
	36,	40,	45,	48,	54,	60,	64,	72
Relative frequency.	1,	10/9,	5/4,	4/3	3/2,	5/3, (A)	16/9*, (A)	2
Intervals ..	10/9	9/8	16/15	9/8	10/9	16/15•	9/8	

* See difference in value from frequency obtained in probable Hanuma-thodi (3) scale.

(A) These are really notes obtained at the positions on the Pa string of a Ga (5/4) and a Ma (4/3) from Ma, if we make Ma as fundamental.

Fig. 6.

Here A or Trisruti Da is fundamental. May be Nata-Bhairavi (Melakartā 20). Asaveri ṭhat in Hindustani Hypo-Dorian Mode. (Aeolian).

	A	B	C	D	E	F	G	A
	40,	45,	48,	54,	60,	64,	72,	80
Relative frequency.	1,	9/8,	6/5,	27/20*,	3/2,	8/5,	9/5,	2
Intervals ..	9/8	16/15	9/8	10/9	16/15	9/8	10/9	

* Out here from the true fourth 4/3. We have to decrease it to 4/3; the 3rd and 4th intervals are then changed to 10/9 and 9/8 respectively. Then the notes are those of a minor chord (1, 6/5, 3/2) from Sa Ma and Pa (1, 4/3, 3/2.)

Fig. 7.

Here B or Kakali Ni is fundamental. Same as practically Hanumathodi, except for the fifth.

	B	C	D	E	F	G	A	B
	45,	48,	54,	60,	64,	72,	80,	90
Relative frequency.	1,	16/15,	6/5,	4/3,	64/45*,	8/5,	16/9†,	2
Intervals ..	16/15	9/8	10/9	16/15	9/8	10/9	9/8	

This scale is discarded in use.

* Out here from true fifth.

† See difference here.

Thus, it is *perhaps* the order of semi, minor, and major tones from the fundamental or Adhara sruti, that gives the raga (melody type) effect, when the drone is kept up. In a later chapter I shall discuss the characteristics of these six ragas of South India.

Now let us see what mathematical ratios have been obtained from this process, considering them as relative frequencies in relation to the fundamental frequency 1. We get the following 19 fractions. 1, 16/15, (10/9, 9/8), (32/27, 6/5), 5/4, (4/3, 27/20), 45/32, 64/45, (40/27, 3/2), 8/5, (5/3, 27/16), (16/9, 9/5), 15/8 and 2. The figures in brackets have the ratio of 81/80 to each other. *See* Fig 8.

Fig. 8.

Values (19) found in relation to fundamental, mathematically.

Sa	ri	Ri	ga	Ga	Ma	ma	Pa	da	Da	ni	Ni	Sa
C	d	D	e	E	F	f	G	a	A	b	B	Ċ

Relative Frequencies.

1	16/15	10/9	32/27	5/4	4/3	45/32	3/2	8/5	5/3	16/9 $=(4/3)^2$	15/8	2
		or 9/8	or 6/5		or 27/20	or 64/45	or 40/27		or 27/16	or 9/5		

Possibilities, 5 more values (a comma flatter or sharper). (See later)

ri		Ga	da	Ni
$\frac{81}{80}$	$\frac{256}{243}$	$81/64 = (9/8)^2$	$\frac{128}{81}$	$\frac{243}{128}$

Discarding 81/80 and 40/27, since Sa and Pa cannot change in melody, the 22 sruits given above are from the Sa Pa and Sa Ma bases.

The next question, we have to ask ourselves, is "Have these relative frequencies any definite recognizable musical values for the ear, or should one merely say that they are just slightly out from the definitely conceived musical notes in relation to the fundamental? If so, what are the clearly definite musical notes in relation to the fundamental, say of the vocalist? The Indian Theory is that there are definitely 22 known and recognizable pitches* within the octave. Are there not any more, which we use in melodic music? How many of these can be definitely elongated *straight* for a decent interval of time without a quiver, or a graceful movement or can be produced similarly on the instrument to have a sonorous effect?†

Let us now turn our attention to the difficulties in tuning the Vina, or fixing the *mela* as it is technically known. I may say that the difficulties are practically and intrinsically the same as have been met with in the tuning of the Piano. I must first mention a few facts about the

* The technical word is 'sruti'. This word has also another meaning referring to the combined music of the Drone in unison; or again we say of a musician that he sings without sruti, *i.e.*, his music is dissonant (is not merging with Sa and Pa of the drone.) *See also* Appendix I.

† The replies to these questions will be found in Chapter VI.

frets. They are placed on the Vina purely by a "trial and error" method. The bridge itself is broad and curved and the strings slope from the head '*meru*' to the bridge so that as we go away from the bridge, the frets which give a higher pitch may not strike the string. The open playing strings are nowadays tuned in relative frequencies of 2, 3/2, 1, and 3/4, Sa, lower Pa, lower Sa and still lower Pa, counting from the first string nearest to the position of the player. Vide picture.*

The first frets, as I have already stated, which are placed for the Sa string are at relative frequencies 2, 3/2, 4/3, 5/4 and 5/3 (if the fundamental is taken as 1) at which upper partials are heard by just lightly touching at the point, as the fret is immediately below the string, And *every effort is made to obtain the upper partials at those points.* The corresponding points on the Pa string (Frequency 3/4) below, will give frequencies 3/2, 9/8, 1. 15/16 and 5/4. *The positions giving upper partials on Pa string also are not changed.*

Footnote. Hence the statement made by Mr. Fox Strangways in his essay on Music in "Legacy of India" (page 311), Oxford Clarendon Press, that the Indian regards 27/16 as the natural note, while the European regards 5/3 as the natural note is fully *disproved* by the actual position of the frets in the *South Indian Vina* of Dhaivata or A.

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* The bottom strings twanged for rythm are tuned at frequencies 2, 3 and 4 if the first playing string nearest the player is taken as 2, *i.e.*, Sa Pa Sa if the said first string is Sa.

3. A vertical view of the Vina

I shall now state what the upper partials referred to are. They are better understood by reference to the violin itself. The South Indian tunes the strings of the violin as Sa Pa and Ṡa Ṗa, the silver string being Sa of the first octave, then the two catgut strings being the Pa and Ṡa and lastly the steel string being Ṗa. *i.e.*, at relative frequencies of 1, 3/2, 2 and 3 respectively, that is, as octaves of the first and true fifths of the fundamental.

The reason why he tunes the violin thus is to be found in the fact that he desires the occasional effect of the drone in his ear, so essential for melody.

If the silver string and Pa string are bowed powerfully together, one can see the whole silver string vibrating in one, two, three, four or five loops or at least their nodal points dying out. If the string vibrates in one single loop, the fundamental Sa is heard. If the player lightly touches the middle point, the vibrating string will appear in two loops, and the note Ṡa (relative frequency 2) is heard, which is really the fundamental note of the catgut string next to the steel string. If he lightly touches the string at the third aliquot part from below, he will hear the Ṗa of the higher octave, relative frequency 3, which is the fundamental note produced by the open steel string.

If he lightly touches at the fourth aliquot part of the silver string from below, the string will divide itself into four loops and he will hear the still higher Sa or S̈a, relative frequency 4, the beginning of the next but one

octave from the fundamental of the silver string, or what will be produced by pressing *tightly* on the steel string Pa at a fourth aliquot part from below.

If he lightly touches the silver string at the fifth aliquot part from below, he will hear Ġa, that is relative frequency 5, *i.e.*, a major third higher than Ṡa referred to in para above. It will be the Ga in the *second* octave from the Sa of the silver string.

On some occasions, at the fifth aliquot part of the silver string, if one slightly lowers the point touched by a millimetre, one can hear a very high Pa, frequency 6 probably. I do not know the reason thereof.

If one similarly lightly touches at 2/5ths of the silver string from below, one will hear the Ġa, relative frequency 5 in the second octave, just exactly the same note as that produced by touching lightly the string at the aliquot part 1/5 from below. But the note produced by pressing at that point, that is, if 3/5ths of the string alone vibrates without the bottom portion doing so, will be the Trisruti Dhaivata of relative frequency 5/3 (or A).

If one plays the Pa string similarly, that is the catgut string next to the silver string, one will hear when *lightly* touched at its aliquot parts 1/2, 1/3, 1/4, 1/5, and at 2/5ths from below, or the head, the notes Ṗa R̈i Ṗa N̈i N̈i of relative frequencies 3, 9/2, 6, and 15/2 and 15/2, respectively.

Now let us turn to the placing of the frets on the Vina. But before I actually do so, I may notice certain facts about the harmonium or the piano. The reader will have realized that if Sa is the fundamental with frequency 1, then Suddha Madhyama has relative frequency of 4/3 and Panchama of 3/2. They are true fourths and fifths of the fundamental. One can make no mistake at all about these swaras Suddha Madyama and Panchama, as each coalesces with Sa.

Let us proceed on the harmonium by raising our pitches from the first white key, by going up the Sa-Pa method or by intervals of Pa from each note obtained. If we proceed from Sa by a Pa interval, we get the Chatusruti Ri key. Here we drop an octave, and if from the Chatusruti Ri in the 1st octave we proceed an interval of Pa, we get the Chatusruti Da key. Of course, I mention the names of these notes as in common parlance. Then, on a further Pa interval, we get the key of Antara Gandhara; we drop an octave here, *i.e.*, to the same key in the 1st octave; go a further Pa, and we get Kakali Nishada; on a further Pa, we get Prati madhyama of the higher octave, drop an octave here, and on a further Pa, we reach Suddha rishaba (Carnatic); we again drop an octave; on a further Pa we get Suddha dhaivata (Carnatic); then by a further Pa we reach Sādharana gāndhara; again drop an octave, a further Pa takes us to Kaisika nishada; then by further Pa we reach Suddha Madhyama; again drop an octave to Suddha Madhyama in the 1st octave and go up a Pa interval, we then get the higher Sa.

So, roughly, by proceeding by Pa intervals, the twelve notes (pitches) in the octave are reached, dropping where necessary, an octave, when we are getting on to the higher octave.

Similarly, if one proceeds by an interval of Suddha Madhyama from Shadja, the first note will be Suddha Madyama, the next will be Kaisika nishada, the next will be Sadharana gandhara, reaching in order Suddha dhaivata, Suddha rishaba, Prati madhyama, Kakali Nishada, Antara Gandhara, Chatusruti Dhaivata, Chatusruti Rishaba and then Panchama, and one finally can come back to the Sa itself; but we must of course drop some four octaves in the process.

Let us mathematically examine this position to see if it is perfectly correct. The following table will show that we are slightly *out* in this process, as can be seen from the working.

i. Sa $1 \times 3/2 = 3/2 =$ Pa
ii. $3/2 \times 3/2 = 9/4$

Here we drop an octave, we have 9/8 Ri.

iii. $9/8 \times 3/2 = 27/16$, that is Dha.
iv. $27/16 \times 3/2 = 81/32$

Here we drop an octave, we have 81/64 (Antara Gandhara sharper by a comma, (Rel. frequency 81/80) than 5/4.)

v. $81/64 \times 3/2 = 243/128$, Kakali Nishada, a comma sharper than 15/8.
vi. $243/128 \times 3/2 = 729/256$

Here we drop an octave, we have 729/512.

We have to equate this to 64/45, Prati madhyama, the reason for which I shall explain later, as the difference is small and not distinguishable.

vii. $64/45 \times 3/2 = 32/15$

Here we drop an octave, and have 16/15 Suddha rishaba.

viii. $16/15 \times 3/2 = 8/5$ Suddha dhaivata

ix. $8/5 \times 3/2 = 12/5$

Here drop an octave, we have 6/5 Sadharana gandhara.

x. $6/5 \times 3/2 = 9/5$ Kaisika nishada

xi. $9/5 \times 3/2 = 27/10$

Here drop an octave, we have 27/20, which is a comma sharper than Suddha Madhyama 4/3.

$27/20 \times 3/2 = 81/40$

Here drop an octave, we have 81/80, a comma sharper than Sa.

Similarly, if one goes up by Suddha Madhyama intervals, from Shadja, we have the following calculations.

i. $1 \times 4/3 = 4/3$ Suddha Madhyama.

ii. $4/3 \times 4/3 = 16/9$ Kaisika nishada, a comma 81/80 flatter than Kaisika nishada, obtained in the previous calculation

iii. $16/9 \times 4/3 = 64/27$

Here drop an octave, we have 32/27 Sadharana gandhara a comma flatter than the Sadharana gandhara obtained in the previous calculation.

iv. $32/27 \times 4/3 = 128/81$, we have Suddha dhaivata, a comma flatter than 8/5 obtained in the previous calculation

v. $128/81 \times 4/3 = 512/243$

Here drop an octave, we have 256/243, that is a comma flatter than 16/15 Suddha rishaba obtained in the previous calculation.

vi. $256/243 \times 4/3 = 1024/729$, Here we equate this as equal to $45/32$ = Prati madhyama, holding the relation of Kakali Nishada (or 15/8) of Panchama.

vii. $45/32 \times 4/3 = 15/8$ or Kakali Nishada

viii. $15/8 \times 4/3 = 5/2$

Here drop an octave, we have 5/4 or Antargata Gandhara.

ix. $5/4 \times 4/3 = 5/3$ Trisruti Dhaivata, or a comma below Chatusruti Dhaivata 27/16

x. $5/3 \times 4/3 = 20/9$

Here drop an octave, we have 10/9 Trisruti Ri, that is a comma flatter than Chatusruti Ri.

xi. $10/9 \times 4/3 = 40/27$, or a comma flatter than Panchama 3/2.

It is thus easily seen that in the tuning of the Piano, or the harmonium, we cannot get all the twelve pitches correctly in the relation either Sa—Ma or of Sa—Pa.

The European theory of Piano tuning is that each note must bear the same ratio to the next higher note among the twelve keys; that is, the musical interval between each key is really the 12th root of 2. If you deno-

minate the logarithm of the number 2 as equal to 1200 cyclic cents, each of these 12 notes of Sa, ri, Ri etc. flats and sharps would rise by 100 cents, that is each of the corresponding notes will have relative frequencies of 2^0, $2^{1/12}$, $2^{2/12}$, $2^{3/12}$, and so on or in logarithmic cyclical cents of 0, 100, 200, 300, 400, 500, 600, 700, 800, 900, 1000, 1,100, and 1,200 being the octave.

The following paras and figs. 9-10 may not be read by any one who does not know logarithms.

Now we can easily work out the frequency 3/2 as equal to 702 cents.

Working.

The ratio of log 3/2 to log 2 $= x$:1200.

$$x = \frac{1200 \times \log 1{\cdot}5}{\log 2} = \frac{1200 \times {\cdot}1760913}{{\cdot}3010300}$$

$$\begin{array}{lcl} \log {\cdot}1760913 & = & \bar{1}{\cdot}2457421 \\ \log 1{,}200 & = & 3{\cdot}0791812 \\ \hline \text{Add} & & 2{\cdot}3249233 \\ \text{Subtract } \log {\cdot}30103 & & \bar{1}{\cdot}4786098 \\ \hline \log x & = & 2{\cdot}8463135 \\ \text{or } x & = & 701{\cdot}962 \text{ or } 702 \text{ in cyclic cents.} \end{array}$$

Similarly, the frequency 4/3 can be calculated to be equal to 498 cents. Thus the octave is seen by addition to be 1,200 cents.

Now the ascent of the pitches by the Sa-Pa and Sa-Ma bases can be also worked out by logarithmic cents.

Fig 9.

Sa Pa

i. 0+702=702=(3/2)

ii. 702+702=1404; deduct 1200
204=9/8

iii. 204+702=906=27/16=884+22

iv. 906+702=1608; deduct 1200
=408=81/64=5/4×81/80
=386+22

v. 408+702=1110 or 1200-112+22 (15/8×81/80)
=243/128.

vi. 1110+702=1812; deduct 1200
612; drop 2 cents
610=64/45.

vii. 610+702=1312; deduct 1200
112=16/15.

viii. 112+702=814=8/5

ix. 814+702=1516; deduct 1200
316=6/5

x. 316+702=1018=(1200-182)
=9/5

xi. 1018+702=1720; deduct 1200
=520
=(498+22)=27/20
or 4/3×81/80, a comma above Ma

xii. 520+702=1222
deduct 1200; we have 22=81/80
a comma above Sa

Fig. 10.

Sa Ma

i. 0+498=493=4/3

ii. 498+498=996=16/9 or (1200-204)=2÷9/8

iii. 996+498=1494

deduct 1200 or 294=32/27

iv. 294+498=792=128/81

v. 792+498=1290

deduct 1200

=90=256/243

vi. 90+498=588

Add 2 cents here

=590

=45/32 (or 3/2÷16/15)

vii. 590+498=1088=15/8

viii. 1088+498=1586

deduct 1200

386=5/4

ix. 386+498=884=5/3

x. 884+498=1382

deduct 1200

=182=10/9.

xi. 182+498=680 or 702-22

or 3/2÷81/80

or 40/27, a comma less sharp than Pa.

We have equated in the method of direct calculation relative frequencies of 729/512 and 64/45. Their relationship is equal to

$$\frac{729\times45}{512\times64} \text{ or } \frac{32805}{32768}$$

Similarly, in the other calculation we have equated 1024/729 and 45/32. Here also the ratio is

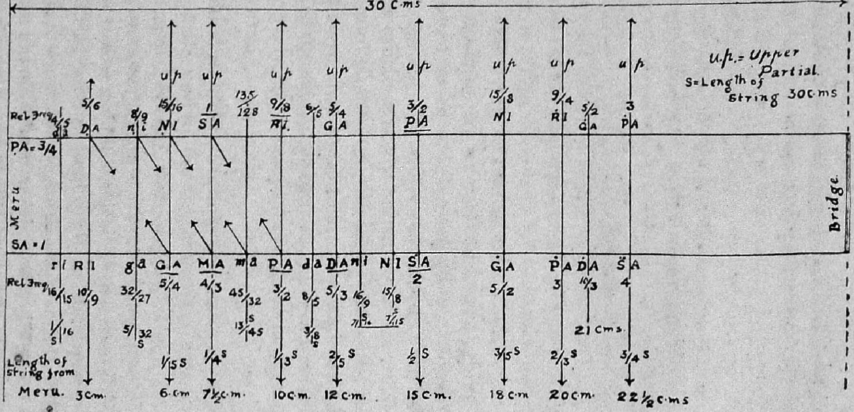
$$\frac{1024 \times 32}{729 \times 45} \text{ or } \frac{32805}{32768}$$

that is the same ratio as above. This works out to barely 2 cents difference, and is hardly distinguishable by the finest ear.

A preliminary question may be asked whether there were any musical terms to define musical intervals, prior to the determination by Physicists of the relative frequencies. Yes. The intervals were called, as I have already said, major tones, minor tones and semi tones. An octave is made up, as we can see now, of three major tones, two minor tones and two semitones. Similarly, by the current use of the word "Chatusruti" Rishabha in South Indian music which is stated to be the relation of Ma to Pa, from Sa, meaning thereby four srutis, we may perhaps conceive that the Indian was also conscious of the terms Trisruti and dwisruti, meaning three and two srutis respectively, to represent these three intervals of the major, minor and semi tones.

The actual method of tuning the piano is to proceed by the true fifths and by the true fourths and then to split the difference of 24 cents of the octave, which results in these two processes among the twelve keys, by count of beats. The same problem, seeing that the strings are tuned as Sa Pa, must present itself in the tuning of the Vina. And if we are to proceed alike in the fretting of the Vina, we should come to this very trouble, and we would never have been able to fix them at any *natural*

Fig 11



30 C.ms
U.P. = Upper Partial.
S = Length of String 30 C.ms
Bridge
Meru
PA = 3/4
SA = 1
Rel. Freq.
Length of string from Meru.
3 cm.
6 cm
7½ c.m.
10 c.m.
12 c.m.
15 c.m.
18 c.m
20 c.m.
21 c.ms.
22½ c.ms

notes. The Tanjore musician has actually fixed the twelve frets on the Sa string in the octave at the *lower* of the two *twin* frequencies, except for 16/15 and 8/5. The Vina frets, *as estimated by musical comparison* on the Sa string are at relative frequencies 1, (the open string) 16/15, 10/9, 32/27, 5/4, 4/3, 45/32, 3/2, 8/5, 5/3, 16/9, 15/8, and 2. *We cannot evaluate these values on the lengths of the strings as the bridge is broad, and the point of contact cannot be exactly determined.*

If you see Fig 11, you would observe that the tuner goes backwards from Ga on the Sa string to lower Da on Pa string *i.e.*, from 5/4 to half of 5/3. $(1/2 \times 5/4 \times 4/3)$; and then he fixes the Ri 10/9 on Sa string $(5/6 \times 4/3)$. Similarly, he goes back from Ma to ni fixing the ni, at half of 16/9, and the ga would be corresponding to the frequency 32/27. He similarly comes *forward* from Ni, half of 15/8 to ma 45/32 $(1/2 \times 15/8 \times 3/2)$ ma sharp.

If we now just evaluate what would be the notes on the Pa string, we will find them to be of the following values.

	Pa	da	Da	ni	Ni	Sa	ri	Ri
1/2 of	(3/2,	8/5,	5/3,	16/9,	15/8,	2)	135/128	,9/8,
		ga	Ga	Ma	ma	Pa		
		6/5,	5/4,	4/3,	45/32,	3/2.		

so that even among the frets which compare with ri Ri ga, with values of 135/128, 9/8, and 6/5, it is seen they do not tally with ri, Ri, ga, of values 16/15, 10/9, and 32/27 placed on the Sa string. The reader who has followed me so far may just observe that I have in this chapter merely elaborated what has been stated perhaps,

in less than a dozen lines in Helmholtz's "Sensations of Tone" (Ellis's Translation). But I have done so with a purpose, as he will see in the succeeding chapters.

Two tables below give definite names to the 22 frequencies, which have just been obtained. Of course, we ignore the ratios 81/80 and 40/27, which we have obtained in this process, because for melodic purposes, Sa and Pa can never be changed. We must probably expect variations in the other *ten* pitches in the octave, which have been placed on the frets of the Vina, and which the voice might actually find it easy to follow in melody.

TABLE III.

Relationship of Shadja (Sa)	Panchama (pa) among srutis	Sign.	Frequency within octave.
1	2	3	4
Shadja=Sa=1	Panchama=3/2	Pa	3/2
Panchama	Chatusruti Rishaba	Ri_2	9/8
Chatusruti Ri	Chatusruti Dhaivata	Da_2	27/16
Chatusruti Dha	Tivra Gandhara	Ga_2	81/64
Tivra Gandhara	Tivra Nishada	Ni_2	243/128
Tivra Nishada	Tivra Tara madhyama	ma_2	64/45
Tivra Tara madhyama	Dwisruti rishaba	ri_2	16/15
Dwisruti rishaba	Dwisruti dhaivata	da_2	8/5
Dwisruti dhaivata	Sadharana gandhara	ga_2	6/5
Sadharana gandhara	Kaisika nishada	ni_2	9/5
Kaisika nishada	Tivra madhyama (a comma sharper than Ma 1)	Ma_2	27/20

Relationship of Shadja Suddha Madhyama among Srutis

Shadja Sa=1.	Suddha Madhyama	Ma_1	4/3
Suddha Madhyama	Madhya nishada	ni_1	16/9
Madhya nishada	Madhya gandhara	ga_1	32/27
Madhya gandhara	Ekasruti dhaivata	da_1	128/81
Ekasruti dhaivata	Ekasruti rishaba	ri_1	256/243
Ekasruti rishaba	Prati madhyama	ma_1	45/32
Prati madhyama	Kakali Nishada	Ni_1	15/8
Kakali Nishada	Antargata Gandhara	Ga_1	5/4
Antargata Gandhara	Trisruti Dhaivata	Da_1	5/3
Trisruti Dhaivata	Trisruti Rishaba	Ri_1	10/9
Trisruti Rishaba	(a note which is a comma 81/80 flatter than Pa)		40/27

N.B.—These are the values which have been given by Fox Strangways in his book "The Music of Hindustān" and in 'the Legacy of India' Oxford University Press (1937) *already quoted, also by Dr. Robert Lachmann in 'Zeitschrift Für verg leichende Musikwissenchaft, January 1933 in the article "Indische Tonsystem Bei Bharata".*

A reference is now invited to Fig 8, and it will be noticed that 22 srutis have been denoted in the 18 ratios in the top part, and 4 others in the line below.

I shall use the indexes to the twelve symbols given in the Preliminary note, where I am particular regarding the pitch used in the melody.

TABLE IV.

(Same as Table III except that the arrangement is in the order of pitch.)

	Frequency Ratio	Cyclic cents	Symbol	
Shadja	1	0	Sa	
1 Eksruti rishaba	256/243*	90	ri_1	
2 Dwiruti rishaba	16/15	112	ri_2	
3 Trisruti Rishaba	10/9	182	Ri_1	
4 Chatusruti Rishaba	9/8	204	Ri_2	
5 Madhya gandhara	32/27*	294	ga_1	
6 Sadharana gandhara	6/5	316	ga_2	
7 Antargata Gandhara	5/4	386	Ga_1	
8 Tivra Gandhara	81/64*	408	Ga_2	
9 Suddha Madhyama	4/3	498	Ma_1	
10 Tivra Madhyama	27/20*	520	Ma_2	Dif
11 Prati Madyama	45/32*	590	ma_1 }	20
12 Tivra Tara madhyama	64/45*	610	ma_2 }	Cents only.
13 Panchama	3/2	702	Pa	
14 Ekasruti dhaivata	128/81*	792	da_1	
15 Dwisruti dhaivata	8/5	814	da_2	
16 Trisruti Dhaivata	5/3	884	Da_1	
17 Chatusruti Dhaivata	27/16	906	Da_2	
18 Madhya nishada	16/9*	996	ni_1	
19 Kaisika nishada	9/5	1018	ni_2	
20 Kakali Nishada	15/8	1088	Ni_1	
21 Tivra Nishada	243/128*	1110	Ni_2	
22 Tara Shadja (higher)	2	1200	$\dot{S}a$	

When a European musician hears Indian melodies, he usually observes that the Indian uses quarter tones. Whether any one has determined scientifically the exact value of the quarter tone is the next question.

I have already introduced to you the word small semi tone; and in Helmholtz's "Sensations of Tone" 'Ellis' translation, a small semi tone is stated to represent the frequency ratio of 25/24. I doubt whether this ratio has been scientifically determined to be actually in use by us. Perhaps, we are apparently covering our ignorance by a word. Yet we do not find the *small-semitone* interval between the frequencies obtained in this chapter. I doubt if the human voice in current melodic music ever *directly* reaches the notes of these *complex* fractions like 256/243, 32/27, 81/64, 27/20, 45/32, 64/45, 128/81, 16/9, and 243/218 (asterisked), when the drone is kept up.

Let me give the reader also a hint as to how a distinction can be realised between the Trisruti Ri (Frequency 10/9), and the Chatusruti Ri (Frequency 9/8), which are both formed at aliquot parts of the Sa string at 1/10th and 1/9th from the head. I have already said that Chatusruti Ri should be sounded as a Pa interval from (lower) Pa. The Trisruti Ri can best be recognized by pronouncing Suddha Madhyama and dropping to Ri immediately. Then he will find that he drops a *minor third* interval of frequency 6/5, and the note 10/9 is reached. For example, in 'Viriboni' Ata tala varna in raga Bhairavi of South India, when we say ṇi, Sa, Ri, , , the Ri which is very elongated is Trisruti. Unfortunately, it is made to coalesce with (lower) Pa on the violin, but this should

not be done so for a better realization of the Raghabhava. I may add another instance. When we say in the Yadukula Kambodi |Sa Ri Ga, Ga,| the Ri must be Trisruti (10/9) to produce the proper effect, whereas when we play Sankarabharana, |Sa, Ri Ga| Ma Pa, ,| the Ri will rise to the Chatusruti.

In this scheme, as formulated by Fox Strangways and others, three important musical notes 7/6, 7/4, and 7/5, are missing if we restrict ourselves to the scheme of 22 srutis or Sa-Ma, Sa-Pa bases only. I recognize them by their resonance and upper partials as I play them on the violin. They are beautiful notes, and are certainly in use in South Indian melodies. These are all prolongable notes also, and I shall refer to them later. (See Page 39).

The South Indian might ask me in what niches I have to place the Swaras Suddha gandhara and Suddha nishada, and Swaras *Shad*sruti Rishaba and *Shad*sruti Dhaivata, names given to certain notes in the 72 Mela raga scheme. (See Chapter XI).

After listening to the composition *Mela Raga Malika* of the late Maha Vaidyanatha Sivan, as sung by his pupil Vidwan Sri Sabesa Iyer, I have come to the following conclusion.

		Commonly stated to be	My opinion
1	Suddha gandhara	Chatusruti Rishabha	Trisruti Rishabha (10/9)
2	Suddha nishada	Chatusruti Dhaivata	Trisruti Dhaivata (5/3)
3	Shadsruti Rishabha	Sadharana gandhara	Frequency 6/5 harmonic on Sa string
4	Shadsruti Dhaivata	Kaisika nishada	Frequency 9/5 harmonic on Pa string

The word Shad meaning 'six' tallies with my interpretation, as the *sixth* note in the scheme of notes obtained from Sa-Pa and Sa-Ma bases since Chatusruti Ri is the 4th Ri.

APPENDIX TO CHAPTER I

The sruti intervals, as explained by Fox Strangways and others, are *not* treated as of equal extent. But an explanation, as if the Indian Theorist treated them as equal, is offered by Mr. Ranade in his book 'Hindustani Music, an Outline of its Physics and Aesthetics' (vide pages 33 and 34) just as the European has held for his Piano the 12 intervals in the octave as equal.

As the frequency relation of the fundamental to the octave is as 1:2 and if the 22 srutis are equal to the extent of 'r', then $2=r^{22}$, the first sruti is $2^{1/22}$, and the

subsequent srutis are $2^{2/22}$, $2^{3/22}$ etc. Mr. Ranade has also calculated the number of srutis in each of the important musical intervals by finding the value of r in the equation like $3/2 = 2^{r/22}$.

Interval.		Mathematically derived value of (the No. of srutis in the interval).	Values assigned by the ancient Indian writers.
Octave	2	22	22
Fifth	3/2	12.86	13
Fourth	4/3	9.14	9
Major third	5/4	7.08	7
Minor third	6/5	5.78	6
Major Tone	9/8	3.72	4
Minor Tone	10/9	3.36	3
Just semi tone	16/15	2.06	2
I complete the table			
Minor sixth	8/5	14.917	15
Major sixth	5/3	16.213	16
Minor third from Pa	9/5	18.656	19
Major third from Pa	15/8	19.952	20

He thinks therefore that the Indian was not far wrong in these ideas. The explanation offered is certainly plausible. But since definite names have been assigned to the srutis, I prefer to treat them as recognisable pitches of a harmonic series, as I shall explain later.

CHAPTER II
GAMAKAS AND SRUTIS.

The reader, who has gone through the last chapter may ask "Why all this fuss about fractional ratios*? Do I play melodies with the consciousness of these fractional ratios?" Certainly not. "Why should not the instrumentalists simply follow the human voice and be done with it?" True, on the stringed instruments, which have no frets, the movements are to a large extent indeterminate and just a matter of practice; but in the Vina itself the pull has got to be exerted sometimes from the lower frets to produce the required pitch, as the note on the next fret seems to be higher than that produced at a certain moment by the human voice in a raga. I am aware that even from the same fret of the Vina, the pitch is varied to the extent of four or more swaras. But I am referring to facts like that Sadharana gandhara of Thodi is produced for the Ri fret, the da of Saveri, from Pa and so on. So also does the violinist vary his technique by a manipulation of the tension of the strings and the slightly different position of the fingers for each swara for slides etc., when thus a secondary sensory impression of the sense of touch supervenes. The enquiring mind asks the question, "Is there any law or symmetry in this pulling across the fret, and what is the extent of the pull?" Though for practical purposes of

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* In this book, I shall hereafter refer to frequency ratio numbers, instead of cyclic cents or vibrational values, as these small fractions, numbering 30 or 32, are easy to remember and convey their meaning better to the mind.

notation, the 12 frets and 12 names are sufficient, should we not for a realization of the 'Raga' have a fuller elaboration?

While dealing with this subject of srutis, I cannot but refer to certain attempts in India to produce a harmonium with 22 frets to the octave so that they may find a substitute for the stringed instrument, for, the harmonium is easy to learn. But this much I can say that these 22 frets will not suffice to produce the melodious effect of the Vina or the violin in imitating the nuances and the continuity of the human voice; again because the 22 frets in each octave should have to be fixed for each fundamental pitch of any one singer and it cannot be made to suit singers in other pitches. Further, one cannot definitely affirm when the *twin note* does come in and I am afraid all spontaneity will be lost by the large number of frets. I only ask, why not learn the Vina or the Violin itself and consign to the dust heap the harmonium, instead of attempting to refine it? But even then as I shall have pointed out before the end of this discourse, these 22 srutis, which would be got by the Sa Ma and Sa Pa bases, are not always correct in their application to vocal music, for again, music works itself into a pattern like a chain not easily resolvable.

Some may have read Tolstoi's book, "What is Art?" Many critics do not agree with his views, but I fully concur with his observations about music. He writes, "Art begins where the weebit begins, so far as music is concerned." "Musical execution is only then art, when the sound is neither higher nor lower than it should be,

i.e., when exactly the infinitely small centre of the required note is taken etc. No instruction can make the singer or fiddler take exactly the infinitely small centre of this note, and this is found only by perception. "The teaching of the schools stops where the weebit begins, and consequently where art begins." The idea of the weebit so finely expressed is to be found in our conception of srutis, which present day artists should do well to understand. The light and shade in the delineation of Ragas, the basis of our Art music, depends on these small microtonal changes in the 12 *swara-sthanas.*

In the last chapter, I referred to the fundamental and its upper partials. The whole texture of the tone of a vibrating string is the result of some sort of mixing up of all the notes of various pitches. They can be separated by Helmholtz's Globes.

It is said that the human voice has as many as sixteen upper partials, though the intensity of the higher pitches must be fastly decreasing (as we go up) to a very small figure. If 1 is the fundamental, the pitches which merge in it are 2, 3, 4, 5, 6, 7, 8, 9 and so on. The swaras in the respective octaves are therefore easily determined. The ratios 2, 4, 8 and 16 are all the commencement of higher octaves. The values of other notes in their respective octaves are 3/2, 5/4, 6/4, 7/4, 9/8, 10/8, 11/8, 12/8, 13/8, and 15/8. Reducing them and avoiding repeated ratios, we have 3/2, 5/4, 7/4, 9/8, 11/8*, 13/8, and 15/8.

We are already familiar with four of these seven ratios. Let us first consider only 7/4, leaving out for the present 11/8 and 13/8.

When we strike a piano, at the key C we can easily hear when the note dies out, the swara n̈i (7/4) of the second higher (or next but one) octave. To my mind, it is at this pitch or frequency 7/4, the voice can *catch* the Kaisika nishada, (flat ni) straight way, when the drone is being heard in the air, and *none other*.

Many of our melodies of the great composers start with the *ni* of the middle octave or lower octave thus.

(1) *jana ni ninnvinā* of Subbaraya Sastri in Riti Gaula with notation as below, in seven units of time.

```
1          4      (Sa) |  1          4   |
ṇi   ṇi,   Sa,    ṇi,  |  ga   ri,   Sa,;|
```

The first ni is 7/4 and the second ni is 9/5.

(2) *Enthara* in Harikambodi of Thiagaraja in 8 units of time.

```
|             2           | 3              4             | 5
| * * * ni Da ,, ni Sa,   |  , ni Da ni Sa, ni Da,      | ,,
|          e n   ta ra    |      ni         ta na       |
```

The first ni is certainly 7/4.

(3) Sarva Bhauma Sa keta.

```
              3             4      |
* * * ni ni ni Da     Da Da        |
      sarva bhau          ma       |
5          7  |
Ṡa,,  Sa ni Pa | Da Ṡa ni
sa    ke   ta  | Ra    ma
1
Pa Ma Pa
Ma na
```

The first ni is 7/4 and the second also the same. The ni in Sa ni Pa is 9/5.

The corresponding upper partial of Suddha Madhyama (4/3) has the frequency of 7/3 or 7/6 in the mid octave; the note ga 7/6 is exactly in the same position on the Sa string as ni 7/4 is on the Pa string of the violin. To my mind, the ratio 16/9 cannot be easily pronounced and I do get at it only by first saying Ma, then as Sa in that very pitch, and then saying Ma from the latter pitch. It will then be seen that the note is higher than 7/4 when actually tested.

We have already considered swaras produced at various aliquot parts of the Sa and Pa strings namely 1/2, 1/3, 1/4, 1/5, 1/6, and 2/5. See Pages 7 and 8. On the Ma string, if we have it, we shall have the following relative frequencies 8/3, or $2 \times 4/3$, 2, 16/9, 5/3, 8/5, 10/9 at the same aliquot parts, and we are already familiar with all these swaras. We may consider other *aliquot* parts 1/7, 1/9, 1/10, 1/16, 1/21, and 1/25 parts damped from below.

		Sa string	Pa string	Ma string
		1	3/2	4/3
at	1/7	7/6	7/4	14/9
,,	1/9	9/8	27/16	3/2
,,	1/10	10/9	5/3	40/27
,,	1/16	16/15	8/5	64/45
,,	1/21	21/20	63/40	7/5
		$(7/4 \div 5/3)$		$= (7/4 \div 5/4)$
,,	1/25	25/24	25/16	25/18
			$= (5/4)^2$	

The notes formed on Sa and Pa strings at aliquot parts at 1/21 and 1/25th from the head only remain to be considered. They are in the region between Sa and the Dwisruti rishaba (16/15), and Pa and Dwisruti Dhaivata (8/5), respectively. I have already noticed 7/6 and 7/4. And with 7/5 the last two form a major chord. 7/6 is exactly in the same position on Sa string as 7/4 is on Pa string, and 7/5 is in the Prati madhyama region.

Let us now consider how the voice can *most easily* produce certain swaras, which we can *elongate* straight without any quiver or grace, when the drone of the tambura is heard. The notes of the Sankarabharna mela may be considered first.

Sa. We either say Sa direct or Sa (below), or again the voice may take up (lower) Sa, and come to Sa; or it takes (lower) Pa and goes to Sa in a gamaka (See page 41). It occasionally commences from Da 5/3 or ni (7/4) and stops at Ṡa; similarly for the lower octave.

If we want the chatusruti Ri (9/8) the voice gets to the Pa of the drone and comes to Chatusruti Ri, rising a Pa interval. Similarly Ga is (Sa) Ga; Ma is (Sa) Ma; Pa is (Sa) Pa. Da (Trisruti) can be produced either direct or better still, it is | Sa Da | (and in actual play occasionally the Da is played on Pa string along with the Sa behind, of the violin).

Ni is really (Pa) Ni if one wants to produce the harmonic Ni; and higher Sa is (Pa) Ṡa or (Sa) Ṡa.

At this stage, I do not propose to deal with the other five (vikruti) changing Swaras i.e., flats and sharps which can be so elongated, and I shall do so later.

Ragas are nowadays explained in South Indian Music by Sanchārakrama, *i.e.*, the order of ascending and descending notes (Swaras). In Art music, the syllables, which make up words of the songs have less importance, and the vowel sounds are more predominant, and the rise or fall in pitch is also apparent within the same vowel sound, which is prolonged. The instrumentalist, for record of the same immediately writes it down in each of his twelve *swaras*, to show how the rise or fall in pitch (or swara) occurs.

Gamakas, meaning 'movements', in South Indian Ragas are generally described to fall into 10 or 11 types, as below.

(1) AROHA, Sa Ri Ga Ma Pa Da Ni Ṡa.
may be in threes, fours, fives etc., of the swaras, but in ascending order.

(2) AVAROHA, Ṡa Ni Da Pa Ma Ga Ri Sa
also in threes, fours or fives etc., of the swaras in descending order.

(3) DWANDA | Sa Sa | Ri Ri | Ga Ga | Ma Ma |
(AROHA) and so on.
&
(AVAROHA) Ṡa Ṡa | Ni Ni | Da Da | Pa Pa
and so on.

(4) TRIPUCCHA | Sa Sa Sa | Ri Ri Ri | and so on in threes of the same pitch.

(5) AHATA, | Sa Ri | Ri Ga | Ga Ma | Ma Pa | and so on, in ascent.

(6) PRATIAHATA, |Sa Ni | Ni Da | Da Pa | Pa Ma| and so on, in descent.

(7) KAMPITA really means shake-as, when we say ma (sharp), the voice generally drops from Pa; or it may be movements within the same swara,

(Sa)* (Pa) (Sa)

(8) HUMBITA Pa Sa Ma and other similar movements, passing through the whole string, though no intermediate notes are separately heard.

(9) ANDOLA, | Ma Ga | Sa Ni | etc. The sound starting from the first swara and ending with the second.

(10) SPHURITA, |Sa, Ri Sa Sa| Ri, Ga Ri Ri| and so on;

(11) LINAKA, straight lined or steady note.

These movements may be conceived in every Raga, according to its Arōha (ascent) and Avarōha (descent).

When we can imagine all these movements within the Raga, (with the peculiarity of the *distinctive* Ri Ga Ma Da Ni giving its character) combined with an aesthetic sense as to when these Gamakas are to be used, we get the elaborated Raga Alapana. This also applies to Ragas denominated janya ragas, in which for instance, certain notes of the selected scale are dropped in ascent or descent, and to *Vakra Sampurna* ragas.

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*The swara from which the music starts will be shown above the line in brackets.

Besides, there is the concept of Vadi and Sam-Vadi of the swaras of each raga, (which the South Indian does not now define in his description of the Raga, yet does realise it) namely of what swaras of the Raga are in the |Sa Pa| relationship, or in |Sa Ma| relationship to each other, which enrich the Gamakas.

Let any one try the 'Janta *Varisai*' for *several Mela* Ragas—see Chapter XI, and he will notice how a swara when repeated in each raga changes slightly in character, against the background of the swara of the lower pitch (or fret) than the repeated swara in that scale.

|Sa Sa ri ri Ga Ga Ma Ma|

|ri ri Ga Ga Ma Ma Pa Pa| and so on, eight swaras in each till |Pa Pa da da Ni Ni Ṡa Ṡa|, both in ascent and descent.

It is under these Gamakas or movements, that quarter-tones as they are called, generally occur, and the twenty-two or more srutis are felt by the ear. These movements can be illustrated. See the sentence.—

o ka Va na Cha ru dala nā du sa ho, dara

Ri Ri Ri Ri Ri Ri Ri Ga Ma Ga Ri Ri Sa Sa, Sa, Ri Ga

etc. in *Namorala gimpa* of Thiagaraja in Raga Deva Gandhari.

The swara Chatusruthi Ri (or Suddha Ri in Hindustani nomenclature) repeated six times, shows the *Kampita* Gamaka in Ri. This Gamaka has a larger movement in range than the tremolo of the European music and is really from Trisruti to Chatusruti Ri. The

Humbita Gamaka from lower Pa to Sa therein may be observed for the word 'ho' of the melody.

These srutis may be said to arise also in another manner, namely, that in the technique of high music, the vocal chords easily step, *i.e.*, fall or rise by a *harmonic* interval of 6/5 or 4/3 or 3/2, *i.e.*, say a harmonic sadharana gandhara, harmonic Antara gandhara, a Suddha Madhyama and a Panchama interval, from harmonic notes that is, those formed at aliquot parts of a string or its simple nodal points.

Suppose we stop at Trisruti Da (frequency 5/3 or 5/6) the most important steady note of 'Kambodi' (besides Sa and Pa) which by the way is played occasionally for a sweet effect with the open Sa string, and if we want to pass a 4/3 Suddha Ma interval, we reach 20/9 or 10/9 (Trisruti Ri), as in |Ḍa Sa Ḍa Ri, Sa| and not 9/8 (Chatusruti Ri concording with Pa).

Similarly, from the swara 'Ma' a 4/3 interval is 16/9, and not 9/5, the harmonic note on Pa string. If we want to drop from the Swara Ga 5/4, a 6/5 interval, we reach the note 25/24 and not 16/15. One can therefore notice that the correct delineation of sweetness depends on the correct appreciation of the pitches of these notes, and of the intervals.

Again, say the prominent note in a Raga is Chatusruti Ri (Frequency 9/8) as in Kalyani, and we desire to pass up a 3/2 (Panchama) interval, or drop a 4/3 Suddha Ma interval, the note reached is 27/16. Then it has to be produced, even when it is not a harmonic note, relative

to Sa, but while in relation to Pa it is so, being $3/2 \times 9/8$. This generally appears as a grace movement from 5/3; then it is pronounced generally Dha. See Phrase Ri, , , , , |Dha Ga Ri| Sa Ni Pa| Dha Ni Ṡa Ṙi| Ṡa, , , , , etc.

Notice also the following musical facts.

1. $2 \div 3/2 = 4/3$; a drop of a Panchama from Ṡa= Ma (Ma$_1$)
2. $2 \div 4/3 = 3/2$; a drop of Suddha Ma from Ṡa=Pa.
3. $2 \div 5/4 = 8/5$; a drop of a major third (Antaragata Gandhara) from Sa give Dwisruti da (da$_2$)
4. $4/3 \div 5/4 = 16/15$; a drop of a major third (Antaragata Gandhara) from Ma gives Dwisruti ri (ri$_2$)
5. $3/2 \div 5/4 = 6/5$; a drop of a major third from Pa gives Sadharana gandhara (ga$_2$)
6. $2 \div 6/5 = 5/3$; a drop of a minor third (Sadharana gandhara) from Ṡa gives Trisruti Da (Da$_1$)
7. $4/3 \div 6/5 = 10/9$; a drop of a minor third (Sadharana gandhara) from Ma gives Trisruti Ri (Ri$_1$)
8. $3/2 \div 6/5 = 5/4$; a drop of a minor third from Pa gives Antaragata Gandhara (Ga$_1$)
9. $4/3 \times 6/5 = 8/5$; a rise of a minor third (Sadharana gandhara) from Ma gives Dwisruti da (da$_2$)

10. $3/2 \times 6/5 = 9/5$; a rise of a minor third from Pa gives ni_2

11. $3/2 \times 5/4 = 15/8$; a rise of a major third from Pa gives Ni_1

12. $4/3 \times 5/4 = 5/3$; a rise of an Antaragata Gandhara from Ma gives Da_1

13. $5/4 \div 6/5 = 25/24$; a *small semi tone* from Sa

14. $5/4 \times 5/4 = 25/16$; that is a rise of an Antaragata Gandhara from Antaragata Gandhara gives a *small semitone* above Panchama.

15. $(2 \times 6/5) \div 5/4 = 48/25$. a drop of an Antaragata Gandhara from higher Sadharana gandhara gives a *small semi-tone* flatter than (higher) $\dot{S}$a.

16. $8/5 \div 5/4 = 32/25$; a drop of Antaragata Gandhara from Dwisruti dhaivata gives a small semi tone flatter than Suddha Madhyama.

17. $7/4 \div 5/3 = 21/20$; also $7/6 \div 10/9 = 21/20$.

Major chords;

Coalescing notes when placed simultaneously.

1, 5/4, 3/2; | 4/3, 5/3, 2; | 3/2, 15/8, 9/4;

Minor Chords.

1, 6/5, 3/2; | 4/3, 8/5, 2; | 3/2, 9/5, 9/4;

| 5/4, 3/2, 15/8, | 7/6, 7/5, 7/4. |

CHAPTER III.

RAGA: MAYA MALAVA GAULA.

The reader may perhaps wonder why so far I have not treated of the Maya Malava Gaula raga, (mela 15) in which the first lessons in musical exercises are taught, and in whose janya ragas (Malahari for instance) the first *gitams* (by Purandara Dasa the Kannada musician) are even now taught in the Tamil land. The teaching of first lessons in this raga presumably came into South India with this composer and saint. In the Sama Veda we hear mainly the swaras of Kharaharapriya; even the sloka of the 2nd century A. D. Chatuh Chatuh Chaiva Shadja Madhyama Panchamāh Dve Dve Nishada Gandharau, Tri Tri Rishabha Dhaivatau regarding the srutis, could be understood only if it were interpreted with reference to the swaras of Kharaharapriya. In North India, the swaras of Sankarabharna (Bilawal that) are called 'Suddha' and the first lessons there are in that raga. So, as we came in late to teach Maya Malava Gaula, I shall take it up now.

Maya Malava Gaula (Hindustani Raga Bhairava)

	Sa	ri	Ga	Ma	Pa	da	Ni	Sa	
Frequencies	1	16/15	5/4	4/3	3/2	8/5	15/8	2	if we use swaras which are aliquot parts of Sa & Pa
Interval		$\frac{16}{15}$	$\frac{75}{64}$	$\frac{16}{15}$	$\frac{9}{8}$	$\frac{16}{15}$	$\frac{75}{64}$	$\frac{16}{15}$	

Can we step this interval 75/64, or would the swaras be thus?

	Sa	ri	Ga	Ma	Pa	da	Ni	Sa
Frequencies	1	25/24	5/4	4/3	3/2	25/16	15/8	2
Intervals	$\frac{25}{24}$	$\frac{6}{5}$	$\frac{16}{15}$	$\frac{9}{8}$	$\frac{25}{24}$	$\frac{6}{5}$	$\frac{16}{15}$	

Should, or should there not be a musical interval between each swara as conceived by us, or would the swaras be,

	Sa	ri	Ga	Ma	Pa	da	Ni	Sa
Frequencies	1	16/15	32/25	4/3	3/2	8/5	48/25	2
Intervals	$\frac{16}{15}$	$\frac{6}{5}$	$\frac{25}{24}$	$\frac{9}{8}$	$\frac{16}{15}$	$\frac{6}{5}$	$\frac{25}{24}$	

What the voice actually does in a fairly fast mood, as I judge musically, is that after reaching 16/15 (or even a lower note), it raises itself to 4/3, Ma, *i.e.* by a 5/4 interval, and then drops a 25/24 interval, and again goes to Ma. Ga is presumably therefore really Ma Ga (4/3, 32/25) and Ni is similarly Ṡa Ni (2, 48/25). Thus the oscillation in the Ga and the Ni frets of the Vina in playing Ga Ma and Ni Sa may be understood. The violinist touches Ma itself before lifting his finger to Ga, which sits close to Ma in this raga.

Above Antaragata Gandhara (5/4), the voice does generally stand at two pitches one in gamaka and one 'linaka' between 5/4 and 4/3 *cf.* the (linaka) elongated Ga of Thoshamuga in song Tulasi Dala mulu Çhe Santhoshamuga of Thiagaraja. It is easy to see that this steady

note Ga (the word of the melody is also Ga) is sharper than 5/4.

Or again see Ga in Hamsadhwani varna | ja la ja | Ga, Ri, Sa,;| the first steady Ga is sharper than 5/4 and I do not play this note with the Pa string behind, to produce consonance. What these frequencies are must be left for future consideration.

As already stated the voice has to be fully opened for the note of frequency 5/4, and Sa has to be remembered. It is easy to demonstrate 5/4 as it will be in consonance with Pa string behind, as the violin is tuned in South India.

Again, so far as Ni is concerned, there is a similar sharp sound, Ni just close to Sa (in which the Hindustani music generally stands.) cf. also Ni in

1 2 3 4
xx ri Sa Ni, Sa, ri | Ga ri Ga,; Ma, | „
Me ru za | ma na |

of Thiagaraja in the same raga. The Ni of this raga here is certainly sharper than the harmonic Ni 15/8. It is even sharper than the position to which Ni drops in Kalyani, in Gamaka, from Sa. See charana of Adi Tala Varna of Kalyani. Both do not reach Ni (harmonic) on the violin. Ni,,,,, (which is really Sa Ni Sa Ni Sa Ni) in gamaka of *ni luparani.*

| Ni,;; Sa Da | Sa Ni Da Pa ma Ga ma,| Pa,;;
| ni lu pa ra | ni
4

This probably distinguishes the 70 cent (25/24) interval in Maya Malava Gaula and the 90 cent interval below Ṡa of Kalyani.

If we enunciate the law of musical intervals between successive swaras, we can see that in Maya Malava Gaula in the phrase Sa ri Ga ri Sa we should have the notes 1, 25/24, 5/4, 25/24 and 1. Similarly for Pa da Ni da Pa we have 3/2, 25/16, 15/8, 25/16, and 3/2. As a further illustration of the frequency ratios of 25/24 and 25/16, I may cite a small gitam in Gaula, which runs as follows.

Sa Ṇi P̣a Ṇi Sa ri | ri Ma ri Sa Ṇi Sa

$\frac{1}{2}$ of

1 48/25 3/4 24/25 1 25/24 | 16/15 4/3 16/15 1 24/25 1

(A)

If we designate 25/24 as $ri^{\frac{1}{2}}$ and 25/16 as $da_{\frac{1}{2}}$ the use of these small semi tones are found in the Gitam in Malahari.

1 2 3 1 2 3

Ma Pa da_2 Sa Sa ri | $ri_{\frac{1}{2}}$ Sa (Pa) $da_{\frac{1}{2}}$ Pa Ma

Pa | ri_2 Ma Pa da_2 Ma Pa | $da_{\frac{1}{2}}$ Pa Ma Ga $ri_{\frac{1}{2}}$ Sa

Sa, ri_2 Ma Ga $ri_{\frac{1}{2}}$ | Sa $ri_{\frac{1}{2}}$ Ga $ri_{\frac{1}{2}}$ Sa etc.

(A) There is a definite gamaka of ri at 25/24, and the voice stops there and picks up again at 16/15 as there is a definite *step-up* as the melody goes up to Ma. You will find that in the violin Ni is always played as Sa Ni, and Ni is very sharp, (higher than in Kalyani).

CHAPTER IV.

CERTAIN OUDAVA (5 NOTE) RAGAS.

In Chapter I the changes from the Diatonic scale or Sankarabharana to six other melodies were considered with the change of Adhara sruti. Similarly, five small, but sweet ragas, which are in vogue even in folk songs, may now be taken up. I refer to the ragas Mohana, Madhyamavathi, Suddha Saveri, Suddha Dhanyasi and Hindola (or Malnkos of Hindustani).

Let us start with the frequency ratios of 24, 27, 30, 36 and 48. It will be seen that the intervals between these notes which have frequencies of 1, 9/8, 5/4, 3/2, 5/3 and 2 are 9/8, 10/9, 6/5, 10/9 and 6/5 respectively. We could easily see here that the octave is divided into one major tone, 2 minor tones and 2 minor thirds, ($9/8 \times 10/9 \times 6/5 \times 10/9 \times 6/5 = 2$). Perhaps by the variation of these five intervals to commence from Sa, five different ragas have come into our music.

Raga Mohana.

	24,	27,	30,	36,	40,	48	
Swaras.	Sa	Ri	Ga	Pa	Da	Sa	Both in Aroha & Avaroha.
Rel. Fre.	1	9/8	5/4	3/2	5/3	2	
Intervals.	9/8	10/9	6/5	10/9	6/5		

But the symmetry on the Pa and Sa strings may require Ri to be 10/9 (Ri_1) or Da to be 27/16 (Da_2).

Swaras	1	10/9	5/4	3/2	5/3	2
	Sa	(Ri_1)	Ga	Pa	Da_1	Sa

Intervals		10/9	9/8	6/5	10/9	6/5
or should the music be with intervals	Sa	Ri_2	Ga_2	Pa	Da_2	Sa
		9/8	9/8	32/27	9/8	32/27

What does the voice adopt? The Hindustani music lays stress on Da_1 in Bhoop. In South Indian music both Ri and Da and occasionally Ga are oscillating notes.

Raga Madhyamavati.

Swaras	27,	30,	36,	40,	48,	54
	1	10/9	4/3	40/27*	16/9	2

*Here out of tune from true fifth; should be changed to be 3/2.

	Sa	Ri_1	Ma	Pa(3/2)	ni_1	Sa
Intervals	10/9	6/5	9/8	32/27	9/8	

Would not the symmetry in ascent and descent require ni to be ni_2 or 9/5 when the Swaras would be 1, 10/9, 4/3, 3/2, 9/5 2 and the intervals would be

10/9 6/5 9/8 6/5 10/9:

or should we change the music to be

	Sa	Ri_2	Ma	Pa	ni_1	Sa
with intervals.	9/8	32/27	9/8	32/27	9/8	

or should we have the swaras as

1, 10/9 4/3 3/2 7/4 2

Raga Hindola (or Malnkos).

	30.	36	40,	48,	54,	60
Swara	1	6/5	4/3	8/5	9/5	2
	Sa	ga_2	Ma	da_2	ni_2	Sa
Intervals	6/5	10/9	6/5	9/8	10/9	

Yet we occasionally reach da_2 from *ni*. What does this mean? Does ni_2 change to ni_1 (16/9) or 7/4 on those occasions?

Raga Suddhasaveri.

	36,	40,	48,	54,	60,	72
Swaras	1	10/9	4/3	3/2	5/3	2
	Sa	Ri_1	Ma	Pa	Da_1	Sa
Intervals	10/9	6/5	9/8	10/9	6/5	

or should it be

	Sa	Ri_2	Ma	Pa	Da_2	Sa
	1	9/8	4/3	3/2	27/16	2
Intervals	9/8	32/27	9/8	9/8	32/27	

Da_1 Ma_1 is commonly in use in Hindustani, whereas in South India Ri and Da are both in oscillation when elongated.

Raga Suddha Dhanyasi.

	40,	48,	54,	60,	72,	80
Swaras	1	6/5	27/20*	3/2	9/5	2

*Out of tune from fourth; should be changed to 4/3.

	Sa	ga_2	Ma	Pa	ni_2	Sa
	1	6/5	4/3	3/2	9/5	2
Rel. Intervals then are	6/5	10/9	9/8	6/5	10/9	

Even from the above features noticed we have to change the fourths or fifths in some cases to get a raga concept; much more so, can it be easily seen how the equal temperamental scale of the harmonium or the Piano cannot truly represent the melodic music, with *natural* intervals, even for such simple ragas.

CHAPTER V.

GENERAL CONSIDERATIONS.

Let us now consider the six important ragas which I noticed in the first chapter.

Carnatic Names.

1. Sankarabharana	Aroha.	Sa Ri Ga Ma Pa Da Ni Sa
	Avaroha.	Sa Ni Da Pa Ma Ga Ri Sa
2. Kambodhi	Aroha.	Sa Ri Ga Ma Pa Da Sa
	Avaroha.	Sa ni Da Pa Ma Ga Ri Sa (ni is absent in Aroha).
3. Bhairavi	Aroha.	Sa ga Ri ga Ma Pa Da ni Sa
	Avaroha.	Sa ni da Pa Ma ga Ri Sa (the phrases Sa Ri ga Ma and Pa da ni da are permissible in ascent).
4. Kalyani	Aroha.	Sa Ri Ga ma Pa Da Ni Sa
	Avaroha.	Sa Ni Da Pa ma Ga Ri Sa
5. Kharaharapriya	Aroha.	Sa Ri ga Ma Pa Da ni Sa
	Avaroha.	Sa ni Da Pa Ma ga Ri Sa
6. Thodi	Aroha.	Sa ri ga Ma Pa da ni Sa
	Avaroha.	Sa ni da Pa Ma ga ri Sa (occasionally Pa is omitted in ascent and descent also.

I. Compare Sankarabharana and Kalyani. In the former there is Ma and in the latter ma, which are the only distinguishing features between the two ragas in common parlance. Yet we distinguish the ragas and differentiate them, even though Madhyama, Suddha or Prati, are respectively omitted in the raga for some small interval of time.

Consider the phrases in Sankarabharana and in Kalyani.

Time

1 2 3 4 5
1. Sankarabharana| Sa Ri | Ni Sa | Dha Ni Sa | Pa Dha
6 7 8
Ni Sa | Da Pa | (Ma Pa Da)

1 2 3 4 5 6 7
2. Kalyani | Sa Ri, | Ni Sa Ni | Dha Ni, | Sa Ni Da Pa |
8
(ma Ga Ri)

Before even arriving at the last phrase in brackets above, we can recognise the ragas as different. How do we do so? The ear is certainly not deceived. That there is a physical counterpart, we should naturally imagine. The concept of srutis has therefore to be brought in, for our better understanding of the raga bhava of the two ragas in question. (The difference is even in the first Ri, also in the Ni's.)

Or even, consider the following phrases (in Kalyani) which are played with single bow for each swara.

Ṙi, , , , , | Dha Ġa Ṙi | Ṡa Ni Pa | Dha Ni Sa Ṙi | Ṡa, , , , , etc., or | Dha. Ni Ṡa Ṙi | Ġa Ṙi Ṡa Ni Da Pa, (ma Ga Ri).

We also see that they are both in Kalyani, but not in Sankarabharana.

Note :—I have put in Dha, when in swara singing Da is stressed with an aspirate.

By carefully observing our fingers on the violin and the fingering technique on the Vina too, we can come to the conclusion that the ear perceives this difference of the raga bhava, because the Ga and Ni are generally slightly sharper in Kalyani than in Sankarabharana.

Now-a-days some sing Kalyani raga (of course in their Alapana,) (improvisation) as if it were the Sankarabharana raga with the Panchama Swara as the adhara sruti itself or the fundamental. At least, my ear feels that their singing conveys the bhava of Sankarabharana. This method in my opinion is quite wrong. The Swaras of the Kalyani in this *change* of the mode do compare *roughly* with the notes of the Kalyani in the Sa scale, but they do not convey the Kalyani *bhava*. What happens in their attempt is that the original Ni of the Sa scale is slightly lowered, and we feel it as Ga in the Pa scale, (the harmonic note of the major third in relation to Pa). Similarly also, there is a very small flattening in the prati madhyama of the original Sa scale, and it is felt as Ni in the Pa scale, the harmonic note or 15|8 ratio thereof. These mistakes in the change of model set before us (as for instance, in the Aṭatala varna 'Viriboni' in Kalyani) should *not* be allowed. The sruti concept alone, besides certain other features which I shall dilate upon later, must prevent such a medley or the confusion of raga bhava.

II. Compare again, for instance, Kambodhi and Sankarabharana so far as the swaras Sa Ri Ga Ma Pa Da are concerned. They are stated to be the same. The Ni, Kakali or ni Kaishika, is the only difference in them and yet consider these phrases.

Sankara-bharana. 1. Sa , , Ri | Ga , , Ma | Pa, | Pa Ma Ma, Ga | Ma, Pa, | Da , , Pa.

Kambodhi. 2. Sa Pa, | Pa Ma Ga, Ma Ri Ga, | Ṁa, Pa , , Ri , , | Pa Ma Ga, | Ma Ga Ri, Ġa | Ri Sa Sa, Pa, the vertical lines denote the run of the phrases.

THE TWELVE SWARAS.

	Sa	ri	Ri	ga	Ga	Ma	ma	Pa	da	Da	ni	Ni	Sa
Srutis on Sa Pa and Sa Ma bases in order of ascent. The underlined ratios are those obtained on aliquot parts of Pa and Sa strings or their nodes.		256/243 1=90 cents.	10/9	32/27	5/4	4/3	45/32	3/2	128/81	5/3	16/9= $(4/3)^2$	15/8	2
		16/15 (112 cents.)	9/8= ½ of $(3/2)^2$	6/5	81/64 = $(9/8)^2$	27/20	64/45		8/5	27/16	9/5	243/128	
25/24 or 70 cents above Sa, Ma & Pa.		25/24 =70 cents.					25/18		25/16= $(5/4)^2$				
25/24 or 70 cents below Sa Ma Pa. Total 6.					32/25		36/25= $(6/5)^2$					48/25	
On the basis of the seventh harmonic. Total 5.		21/20 (7/6÷10/9) =85 cents.		7/6=267 cents. 8/7=2÷7/4 or $\frac{4}{3}\div\frac{7}{6}$ =231 cents.	9/7		7/5=583 cents.		63/40 or 3/2×21/20 =787 cents.		7/4=969 cents.		

One does feel the ragas quoted, though the specific nishada does not appear.

Further, you will notice that unaspirated Swara Da is elongated *straight* to six matras of time in Kambodhi raga as in the following example of the varna in Aditala (Taruni).

Da , , , , , ni Pa Da ni ni Da Ma Pa Dha etc., or the elongated word Ra in the phrase Bhakta Paradhi in the charana of Tyagaraja's Kriti Evarimata in Kambodhi, whereas the swara Da is always, more or less, found as oscillating note, whenever elongated in Sankarabharana.

III. Again, there is a lot of mixing of the raga bhava in the Kharaharapriya and of Bhairavi; because of the *accidental* Da (as in Da ni Sa or Da ni Sa Ri etc.) which occurs in the latter. True, the phrase Sa Ri ga Ma is permitted in Bhairavi, but if properly played we need exhibit Bhairavi only, in the phrase | Da ni Sa Ri ga Ma Pa | so that Kharaharapriya bhava is not at all felt, though under the system of 12 frets the notes are said to be the same. Wherein lies the difference in Bhava? Again, without a concept of srutis, one cannot offer a physical explanation.

Or again, take Thodi (carnatic), the swaras ga Ma Pa da ni are alleged to be the same as in Bhairavi; yet we manipulate them differently and we do feel that they are not identical in *bhava*. I shall mention in a following chapter my present conclusions as to the various srutis, which are characteristic of the ragas, as judged by the ear, and to some extent, from the technique of play on the violin or the vina.

From the table summarising all the ratios, which are formed by aliquot parts of strings in the gamut of our melody, we find that there are at least three or four possibilities round about the *ten* frets of the vina in the octave (except of course Sa and Pa which are fixed for the melody.)

From my lessons for over three years from Mr. Purohit, a pupil of the late Pandit Vishnu Digambar, who by the way has done so much for the revival of Hindustani music in the Maharashtra and the Punjab, I learnt that his classification *for all practical purposes* of Hindustani music, as he had taught and written down in his books for the elucidation of his students, is, as follows.

Besides Shadja, Panchama and Suddha Madhyama, he has described three Rishabas, three Gandharas, three Tivra Madhyamas, three Dhaivatas and three Nishadas, making in all 18, which are as under.

Shadja			*Panchama*	
1. Atikomal			1. Atikomal	
2. Komal	Rishaba		2. Komal	Dhaivata
3. Suddha			3. Suddha	
1. Atikomal			1. Atikomal	
2. Komal	Gandhara		2. Komal	Nishada
3. Suddha			3. Suddha	
Suddha Madhyama				
1. Tivra			Tara Shadja (Octave)	
2. Tivra Tara	Madhyama			
3. Tivra Tama				

He has also made mention of one *Ati-Ati*-Komal Rishaba in Puriya Raga, that is to say in all about 19 notes. He has suggested to the student the desirability of his appreciating these microtonal changes, and gives at the head of every raga in which the melody is composed, the particular notes, which according to his classification, enter into the composition. We may denominate these ratios as

Sa ri_1^b ri_1 ri_2 ga_1 ga_2 Ga Ma ma_1^b

ma ma_2 | Pa da_1^b da_1 da_2 ni_1 ni_2 Ni $\dot{S}a$

Since the Suddha notes are the Bilawal Ṭhat, (the same as the Sankarabharana mela) we find in his description of Bhairavi, corresponding to Hanumathodi of the South Indian scale, that it takes the following swaras:—

Sa ri_1^b ga_1 Ma Pa da_1^b ni_1 and Sa

We can ask ourselves the question "Is it possible that the Hindustani musician does *not* realise the possibilities of the variation of *srutis* selected for the particular raga within the Komal (flat) swaras here? Will not the voice attempt a compromise of slightly varying them; and are there not other possibilities of the same Komal swaras arising for instance in Hindustani Bhairavi (or Hanumathodi of South India)? Will not the voice rise on any occasion to ri_1, ga_2 or da_1 or ni_2?

The accidental notes, which the Hindustani musician introduces for a variation in a raga come up to one of the *higher* frets as denominated by the twelve frets of the octave, as the South Indian often notices in his ragas; the South Indian to my mind however, refuses to change the

swaras in his ragas, but introduces only the microtonal changes round about the frets, which can be denominated in 5 vikriti swaras of the selected frets. Is it on this account that the South Indian does not feel in Carnatic music the monotony which he feels in listening to Hindustani music, though he appreciates it, as it is sweet enough for his ear?

After describing the five European modes on the white keys, starting with C, G. D, A and E that correspond to 1 Sankarabharana, 2. Harikambodi 3. Karaharapriya 4. Nata Bhairavi 5. Hanumathodi and the changes they have made in the Nata Bhairavi by introducing in the ascent, the raga Gauri Manohari and in the descent the raga Kiravani, Mr. Fox Strangways a great student of Hindustani music in his article on "Music" in "Legacy of India" already quoted above, goes on to say that in Hindustani (Northern Music) any note (except the swaras Sa and Pa) is subject to enharmonic treatment and he describes the raga as a chosen path of seven notes among the 22 srutis, the Panchama being never altered, though it may be omitted. And he further avers that the Hindustani musician thinks that by the mere change of A or Dhaivata to Trisruti or Chatusruti their Bilawal and the Bihag vary. I do *not* think the South Indian considers that in the same raga the (second) twin (note) sruti of a particular swara should *not* at all come in. It is only the way in which the twin note appears which makes all the difference.

The orthodox South Indian tradition about the use of the srutis is that the srutis are considered as twin notes,

as far as possible, and that in the ascent, (arōha) the higher sruti of the selected swara is used, and in the descent (avarōha) the lower sruti of the selected Swara is used. That is why even in the vina frets, as I have already said, the lower of the twin notes (except for ri and da) have been fixed, as the higher sruti on the vina can be got by the mere deflection of the string across the fret. Of course, there are a few exceptions to this rule, as far as the two prominent notes (besides Sa and Pa) which were defined in the past as the Amsa* and Nyasa notes are concerned. It must also be realized that in South India we close with either the Shadja or the Panchama, while in the north, in Hindustani Music, they do not do so, and they may rest at any note chosen, preferably the first note or of the first phrase of the song. That really makes an important difference in the effect of the raga on the ear.

CHAPTER VI.

REPLIES TO QUESTIONS IN CHAPTER II.

I was able to obtain a brand new set of eight tuning forks of Becker & Co., of the Diatonic Scale, C to Ċ for a musical judgment of the 19 various ratios described in the first chapter, obtained mathematically by change of the fundamental. The results of a careful study of the six ragas got by the change of the fundamental are enumerated below. They can be verified by any student

*Amsa means important; Nyasa means ending note of a phrase.

of music, who has a fine ear. (I could make no temperature corrections, but the major scale as | Sa Ga Pa | | Ma Da Sa | and Pa Ni Ri | was true.)

C Scale. Fig. 1, Page 10.

It is easy enough to notice that the tuning forks D and A are not in Sa-Pa relationship. That is to say Ri and Da are respectively Ri_2 (Chatusruti) and Da_1 (Trisruti) from Sa and Pa respectively.

Scale commencing from D. Fig. 2, Page 11.

The first ratio is 10/9. Singing the Kharaharapriya with D as fundamental, it is found that the tuning fork E gives a pitch less than Ma in Rama of the song Rama Neeyada. The melody here starts with (Pa) Sa (Pa) Ri *i.e.*, with the background of Pa. The Ri is there Ri_2 (9/8). But the tuning fork tallies only with the sound 'bo' in Viribo in the *Viriboni* varna of Bhairavi of South India, starting with the notation | ni, Sa, Ri,; | because the Ri here (of Bhairavi) is Trisruti or Ri_1.

The tuning fork F giving the next ratio 32/27, gives a higher pitch than the ga used in Bhairavi raga in the phrase Sa ga, Ri ga Ma, Pa. The ga in Bhairavi (which is realized as ga_1) is not 32/27 and the probability is 7/6.

The tuning fork C, having a ratio of 16/9 from D is found higher than the ni in Surati raga elongated in descent as in| Sa ni ni, Da Pa.| Hence the surati ni is not 16/9, and is probably 7/4 when elongated. Taking *Ma* of the violin string (tuned D) as shadja and by going up a Ma (exactly singing it) we reach 16/9. This is not, however, even the lower *ni* by the voice.

The tuning fork A with interval 40/27 from D is found less than Panchama, and cannot be identified with any swara. The tuning fork B is Trisruti Da (Da_1) in the scale.

Scale from E (tuning fork) Fig. 3, Page 12 with the adhara sruti taken as E for the music; it is found that 16/15 (tuning fork F) and 8/5 (tuning fork Ċ) are felt sharper than the generally used ri and da of Hanumathodi in the Aṭa Thala Varna. The one instance known to me of the elongated, linaka 'ri' namely in Punnaga Varali (janya in Hanumathodi) in the phrase *Ka na ka cai la vi ha* with notation** ga Ma ga, ; ri, ; Sa, ri ni Sa

Ka na ka cai la vi ha

(2nd ga in Gamaka from Ri_1)

is also found flatter than 16/15. The frets *ri and da* on the Sa string of the Vina examined, which are used much for Maya Malava Gaula also are actually flatter than 16/15 and 8/5.

In the charana of Viriboni varna in Bhairavi,

da, ni ni da da, ni da da Ma

the first elongated da is flatter than 8/5 while the second elongated da is found to be 8/5. (Tuning fork C).

The frequencies 6/5 (tuning fork G) and 9/5 (tuning fork D) are found to be the ga and ni in Ritigaula in the phrases in singing ga ga, and ni ni, (the second elongated swaras). Frequency 8/5 (tuning fork Ċ) is even sharper than the steady notes 3rd and 4th da, found in Kanakangi-

Mela Raga Malika in the phrase '*Sanakadi priya*'-starting with the notation da da (Pa) da, (Pa) da,

sa na ka di

Scale from F Tuning fork Fig 4, Page 12

The music being started with F as the adhara sruti, the ratio 9/8 (tuning fork G) tallies with the word Te in Kaligiyun*te* of the song in raga *Kiravani*: the notation being

(sa)

,, Ri Ni, Sa Ri, Ri, ; ; ga Ri

Ka li gi yum te ga

The ratio 5/4 (tuning fork A) is found less than the Ga generally used in Kalyani in ascent, and it is only the harmonic Ga used in Sankarabharana. In Dikshitar's song in the charana of his Kamalam Bhajare, in the words

Nityakalyani Sa, Ga, Ri, $\overline{\text{Ni, ,Ri}}$ Ga, Sa both Ga's tallied.

Ni tya Kal ya ni

and here Ri becomes Ri_1.

The ratio 45/32 (tuning fork B) is either too sharp for the descending note ma in Kalyani as in Pa ma Ga Ri, and too flat for the ascending note as (Pa) ma Pa.

Regarding the ratio 27/16 (tuning fork D) we find the voice stopped at that frequency in the words *thandri* in Kanna thandri - of the charana of the song.

Pa Pa Da, Da,

Ennaduni in Vachaspati Raga (Sa Ri Ga ma Pa Da ni Sa) of Patnam Subrahmanya Iyer.

The ratio 15/8 is less than Ni in *Nilupa Rani* in charana of the Adi Tala Varna in Kalyani.

From these facts we can see for ourselves how much the Kalyani scale has differed from the Kalyani of the Ata Tala Varna in Kalyani.

Scale from G. Fig. 5, Page 12.

When Kambhodi is sung with G as adhara sruti, the ratio 16/9 (tuning fork F) is found sharper than the swara ni we actually use in| Da, ni Pa Da ni ni Da| Ma, Pa etc.

The note of frequency 16/9 is detected just as a short note, where one would least suspect it, in the raga Kharaharapriya in the following music.

a portion of the charana of Sakhani Raja Marga

; ***ni*** , , Da ni Da Pa Da ni *ni* Sa ni ni Da Da Pa ni Da
im ta ne pa ga ne la

The first underlined ni is flatter than 16/9 and the second underlined ni happens, however, to be 16/9, just as a short note.

Scale starting with the tuning fork A Fig. 6, Page 13

Starting the music with the adhara sruti A. it is found that all the notes given, though stated to be Nata Bhairavi, are sharper than the Bhairavi of South India. One observation may here be made that in the musical experience of myself and others who helped me in this investigation, we ***never*** find in South Indian Music the swara 16/15, and 8/5 elongated straight at all for any large *interval of time.* In Pharaz, as defined by Syama Sastri, a Janya raga in Maya Malava Gaula where the

Panchama is 'varjya' or absent, the flat Dhaivata stands at 8/5! It is probably also the case in South Indian Hindola, or Malnkos of the Hindustani musician.

Here also, in the charana of Viriboni already quoted page 63 - (against the scale of tuning fork E) the first elongated da is flatter than 8/5 and the second elongated da is 8/5. (Tuning fork F).

The ratio of 27/20, that is the tuning fork D, is found *flatter* than Madhyama, though it is in gamaka in the phrase Da Pa Ma, Ga Ri Sa in the Begada varna.

Scale commencing with the tuning fork B Fig. 7, Page 13

Our search for the Prati Madhyama equal to 64/45 in any raga proved futile. In the kritis, in ragas using Prati madhyama it always descends from Pa. There is an Andola Gamaka from Pa to ma and back to Pa, and it is very difficult to distinguish the note 64/45 as used in any of our ragas.

CHAPTER VII.

PROPOSED THEORY OF CARNATIC MUSIC.

Before I state my general conclusions, I should like to make certain simple observations. To my knowledge, the frequency ratios at which the voice can stop and straightly elongate them, *i.e.*, in 'linaka' notes as observed by me in musical compositions in Carnatic music, and in my own musical experience, are the following ratios :—

1, 10/9, 9/8, 7/6 (septimal third), 6/5, 5/4, 4/3, 7/5, 3/2, 8/5 to a small extent, 5/3, 7/4 (septimal seventh), 9/5, 15/8 to a small extent, and 2. (These ratios are obtained by damping aliquot parts of Sa and Pa strings or from their simple nodal points.)

A few examples are given below.

During the course of the investigations themselves I have to a large extent stated where these fourteen ratios are and have exemplified them already. I may state that 7/6 (ga) is specially noticeable in Ananda Bhairavi in the phrase Ri Ma ga Ri Sa. 7/5 (ma) is particularly noticeable in Ramapriya in the phrase Pa Da ni Da Pa ma; At that point ma, I feel a resonance with upper partials. When I bow the string by lightly touching it, I hear the upper partial 7/4, the Surati nishada, which has a relationship of an Antargata Gandhara interval of 5/4 behind 7/4. (7/4÷5/4=7/5). 8/5 (da) is pronounceable only when the panchama is (varjya) absent and the voice steps directly a minor third as in Pharaz of South India. The names which may be given to these notes are

Ratios.	Swaras.	Remarks.
1	Shadja	Where the Srutis occur.
10/9	Trisruti Ri	In Durbar and Madhyamavati when ga is absent.
9/8	Chatusruti Ri	In Kharaharapriya.
"	"	A gap here.
7/6	Madhya gandhara • (Seventh upper partial of Madhyama)	In Bhairavi and Ananda Bhairavi. (Septimal minor third).

6/5	Sadharana gandhara	In Ritigaula when elongated.
5/4	Antargata Gandhara	In Yadukula Kambodhi especially.
,,	,,	A gap here.
4/3	Suddha Madhyama	
,,	,,	A gap here.
7/5	Prati madhyama	In Ramapriya.
3/2	Panchama	
8/5	Dwisruti dhaivata	In Pharaz
5/3	Trisruti Dhaivata	In Kambodi
7/4	(Septimal) ni 7th upper partial of Sa	In Surati
9/5	Kaisika nishada	In Ritigaula when elongated.
15/8	Kakali Nishada	In Sankarabharana

Even the order of the above ratios suggests that

(1) between 9/8 and 7/6 there can be 8/7

(2) between 5/4 and 4/3 we can have 9/7

(3) between 4/3 and 7/5 we can have 11/8, the eleventh upper partial of Sa.

Whether the ratios 8/7, 9/7 and 11/8 may not figure in our music at all, is a question which any investigator should consider; but I have not been able to verify the same for want of facilities.

N.B.—(1) The ratio of 5/4 to 9/7 is 35/36

(2) The ratio of 11/8 to 4/3 is 33/32

(3) $8/7 = 2 \div 7/4$

There is, however, a 'linaka' Ga lying between 5/4 and 4/3; and a 'linaka' Ni between 15/8 and 2 at which

the voice easily stands. I have already given illustrations from actual compositions. To add another illustration, take | Ma, Ga, Sa, ni, Da; ni; Sa, | in Natakurunji. The Ga seems to my ear sharper than 5/4. The Ga may be a ratio of 9/7 from Sa and a similar interval from Pa may exist; but I have no means of verifying them. I do not play the Ga with the Pa string behind on the violin.

Then there is a further problem, whether when the voice reaches these 'harmonic' notes direct, the adjacent note, when descending or ascending, is a semi tone or a small semi tone or a quarter tone from the former. We have noticed two ratios in the course of investigation of less than a semi tone of 16/5 namely 25/24 and 21/20. The ratio 25/24 is the position on the Pa string from Pa when you pass a 5/4 interval from the 5/4 or Antargata Gandhara. The ratio 21/20 is the ratio of 7/4 to 5/3 *i.e.*, from the harmonic (septimal) ni to Trisruti Da. At both these ratios of 7/4 and 5/3 the voice can stand steadily.

It is very probable that from Ri_1(10/9) and from Da_1 (5/3) such a small interval of 21/20 is pronounced and then the respective frequencies so produced 7/6 and 7/4 respectively reached are harmonic notes.

A general observation as regards South Indian music.

i. Take Sankarabharana for instance. We do not produce Swaras if we want to say them as Sa Ri Ga Ma Pa Da Ni as described in the *second* chapter Page 40. If we just want to sing them in an elongated mood, we say Sa $\overline{\text{Ga Ri}}$ Ga the word $\overline{\text{Ga Ri}}$ being repeated even twice

very fastly to represent the Ri. Ma is produced as | Pa Ma | and Dha is produced as | $\overline{\text{Ni Dha}}$ | exactly like Ri from Ga in the ascent.

ii. Take for instance, Bhairavi. When we want to say ga after Ri_1 the voice generally comes down from Ma and it ought to be so, though it is just a slight touch. Probably as the gamaka, the voice reaches 7/6 straight as a harmonic note (it being an upper partial of 4/5) from Ma and as I have already said, the ratio 10/9 or Ri_1 is itself got by introversion from Ma, that is a dropping of minor third from Ma.

iii. Or take Hanumathodi for instance; after voicing da, if we want to say ni, the voice on many occasions goes up to Sa and drops to ni.

iv. Take for instance Karaharapriya or Harikambodi. If after standing at Da, we want to produce ni, it goes up to Sa and drops sometimes to a larger extent and sometimes to a smaller extent. I should imagine therefore that the drop is not by a minor tone and a major tone, but rather to the harmonic notes themselves of 9/5 or 7/4.

From these illustrations we can very well see that the voice in South Indian music reaches from the 'harmonic' notes a longer interval, such as a minor third in some cases, or more, and forms a certain loop before coming down to a lower note, that is to say, the notes work themselves into patterns of loops, and the several swaras are not quite discontinuous and separate as played in the piano, but quite continuous. The importance of the Andolika and Kampita Gamakas between swaras

is thus emphasised in South Indian music, and it is this characteristic of Vina play, which has been impressed on carnatic vocal music.

Even as the present vina fretting goes, there are only three frets, not formed by simple aliquot parts such as 16/9, 45/32 and 32/27, while others are 'harmonic' ratios.

Talking of Vina play, I may say, the more advanced the artist, the more does he play mostly from the Sankarabharana frets, producing the flats and sharps; The Sankarabharana varying from the Diatonic scale, only in the matter of Ri, the South Indian uses 10/9 instead of 9/8. We can therefore certainly imagine that these quarter tones are produced from the swaras, where the voice does stand and can stand easily.

CONCLUSIONS.

As for every fundamental pitch of a singer, the listener is able to say that music is true in every raga which the artist sings or plays, I believe the part of the ear (which appreciates the music and is alike a piano with about 20,000 strings all compressed in a small compass) adjusts itself to *harmonic* notes arising from such Sa and Pa of the singer.

Having found five at least of these *complex* ratios namely $\frac{32}{27}$, $\frac{16}{9}$ 27/20, 45/32, 64/45 and 40/27 on the Sa Pa and Sa Ma bases, *absent generally in our music* and *not present as elongated Swaras*, I presume we have to

discard altogether the bases of obtaining the srutis on the Sa Pa and Sa Ma bases.

Consider the possibilities of the 13 srutis from Sa to Pa being as follows, forming simple harmonic ratios, and forming a harmonic series from 10/9 to 5/4.

	1. Ekasruti rishabha	25/24 or 21/20,	both in Gamaka or as short swaras
	2. Dwisruti rishabha	16/15	(rarely used in elongation)
	3. Trisruti Rishaba	10/9	
	4. Chatusruti Rishaba	9/8	
@ *	* * * *	8/7	
	5. Madhyagandhara	7/6	
	6. Sadharana gandhara	6/5	
	7. Antargata Gandhara	5/4	
@	8. Tivra Gandhara	9/7* = 3/2 ÷ 7/6	
	9. Suddha Madhyama	4/3	
@	10. Tivra madhyama	11/8	
	11. Prati madhyama	7/5	
@	12. Tivratara madhyama	10/7	
	13. Panchama	3/2	

@ Not verifiable with my present facilities.

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* As a probable illustration of the Tivra Gandhara 9/7 I might draw the attention of the reader to the song of Thiagaraja in Sahana beginning with the words *eeva sudha* the notation being Ri, Ga Ma Pa. The Ri starts from very much above Ga (5/4) on the Sa string of violin, and the next Ga is particularly sharp though short but definite and not oscillating. This is a very Tivra Ga in music that I have noticed, in suddha madhyama ragas.

I have already stated that there is a 'linaka' Ga between 5/4 and 4/3 which is most easy for the human voice. Venkatamakhi, the author of "Chaturdandi Prakashika", the principal treatise followed by modern Carnatic musicians says that this is a sruti below Suddha Madhyama, and he calls this Antara Gandhara. That is the reason why I have denominated 5/4 as Antar*gata* Gandhara to avoid confusion. It is surprising therefore that Mr. Clements at page 43 of his book, "Ragas of Tanjore" (London, 1920) makes the statement "The author for some unknown reason makes things worse by putting Antara and Kakali only one sruti below Ma and Sa". I have already given examples where such a linaka note above 5/4 and below 4/3 occurs in our compositions.

We can also enunciate similar positions from Pa up to its Suddha Madhyama position or higher Shadja.

14. Ekasruti dhaivata	14/9* or 25/16 or 63/40.
15. Dwisruti dhaivata	8/5
16. Trisruti Dhaivata	5/3
17. Chatusruti Dhaivata	27/16
@ * * * *	12/7
18. Madhya nishada	7/4
19. Kaisika nishada	9/5
@ * * * *	11/6 See foot note.
20. Kakali Nishada	15/8
21. Tivra Nishada	27/14, 48/25 or 40/21 in gamaka
22. Shadja	2

---

*14/9 is a 7/6 interval from 4/3 just as 8/5 is a 6/5 interval from 4/3.

One may recollect the hot discussion in the Music Academy, Madras in recent years about Nishada and Madhyama used in Raga Begada, which are characteristic of the raga. Some said that it was Kaisika Nishada and others held the opinion that it was Kakali Nishada. In my own mind, I feel it sharper than the Nishada of Ritigaula of 9/5, but flatter than the Kakali Nishada, the harmonic 15/8, and the drop in gamaka is not a minor tone in this case from Sa to ni_2, but something less in extent.

One could also perceive that the drop from the Panchama to the Madhyama of that raga is equal in extent to that from higher Shadja to Nishada. The ratio 3/2 to 11/8, (the latter being an upper partial of Sa) is equal to the ratio of 2 to 11/6, the Begada Nishada, the latter being an exact Madhyama ratio from 11/8. The drop would be 12/11 instead of 10/9.

Mr. Clements in his book "Ragas of Tanjore" has only 18 notes or swaras in use in South India and he styles them as follows, practically following what the late Vishnu Digambar has stated for his Maharashtra-cum-Hindustani music. He has Sa, four Ri's, three Ga's, Suddha Madhyama, Prati Madhyama, Panchama, four Da's and three Ni's. He uses the word "mridu" for the first Rishaba and the first Dhaivata above Sa and Pa respectively. He denominates Mridu rishaba as a ratio 21/20 from Sa as detected by his harmonical. He also considers that we use the ratio 32/27 as 'five srutis'; but my tests with the tuning forks show that the lower note of the "Sadharana gandhara" or ga_1 is not 32/27.

He has not anywhere stated that we are using the note 7/4 at all in South Indian music. Nor has he noticed that the ratio 21/20 is that of 7/4 to 5/3.

It is perhaps necessary for me to point out the difference between the above selected ratios and the notes which have been obtained either on the Sa and Pa and Sa Ma bases, which I reject, and the notes which are just 70 cents or 25/24 above and below Sa Ma and Pa.

The ratio of	7/6	to	32/27	is	189	to	192,	a differ. of	27 cents
„	9/7	„	81/64	„	576	„	567,	„	27 „
„	11/8	„	27/20	„	220	„	216,	„	31 „
„	7/5	„	45/32	„	224	„	225,	„	7 „
„	10/7	„	64/45	„	450	„	448,	„	7 „
„	10/7	„	36/25	„	250	„	252,	„	15 „

Some exception has, however, to be made in respect of 81/64 (9/8×9/8) because it is an upper partial of Ri (9/8) The same thing may be said of 45/32 (9/8×5/4) or 3/2×15/8×½ which is just (Ni) 15/8 of Pa and can only be elongated with some difficulty as in the case of Ni or 15/8 from Sa. It may be added that the first sruti or Ekasruti is not a comma of 81/80, but is a larger frequency of either 25/24 or 21/20 as the raga may require, since we define Dwisruti as equal to 16/15.

The theory that there are 22 pitches only in the octave which are derived from the Sa Pa and sa ma bases does not suffice. The voice stands at particular harmonic notes, which are formed by aliquot parts of Sa and Pa strings or at their simple nodes. The voice generally takes from such harmonic notes a longer reach and then drops to the adjacent note of the selected scale. When it goes direct to an adjacent note by a measure of a pitch of less than the semi tone, the adjacent note itself must be a harmonic note. The possible frequencies to replace

the complex ratios given by Fox Strangways at page 30 which suggest themselves to me are given at pages 72 and 73.

As a mathematical curiosity, the following series strikes me as lying between 1 and 2. The notes in brackets are repetitions.

a. 1, 2
b. (2/2) 3/2, (4/2)
c. (3/3) 4/3, 5/3 (6/3)
d. (4/4) 5/4 (6/4) 7/4 (8/4)
e. (5/5) 6/5 7/5 8/5 9/5 (10/5)
f. (6/6) 7/6 (8/6) (9/6) 10/6 11/6 (12/6)
g. (7/7) 8/7 9/7 10/7 11/7 12/7 13/7 (14/7)
h. (8/8) 9/8 (10/8) 11/8 (12/8) 13/8 (14/8) 15/8 (16/8)
i. (9/9) 10/9 11/9 (12/9) 13/9 14/9 (15/9) 16/9 17/9 (18/9)

Selecting those in probable use in the order of pitch, we have 1, 10/9, 9/8, 8/7, 7/6, 6/5, 5/4, 9/7, 4/3, 11/8, 7/5, 10/7, 3/2, 14/9, 8/5, 5/3, 12/7, 7/4, 16/9, 9/5, 11/6, 15/8, and 2. I do not know where we can possibly use 8/7, 13/8, 13/7, 11/9, 13/9, and 17/9.

CHAPTER VIII.

SIX MAJOR RAGAS.

I. Sankarabharana. Mela 29.

Venkatamakhi Scale.—Sa Ri Ga Ma Pa Da Ni Sa in scent and descent.

Add the following at the end of Chapter VII.

Some further explanation may be added regarding frequency values obtained at nodal points of an oscillating string. It is presumed the tension is constant and only definite portions of the string vibrate. Let the open string be of frequency 1:

No. of Divisions 2:—The note is 2/1.

Do. 3:—The frequencies counting *from the meru* are (3/2); 3/1 at the two nodes.

Do. 4:—The frequencies counting *from the meru* are (4/3); 4/2; 4/1.

Do. 5:—The frequencies are (5/4); (5/3); 5/2; 5/1.

Do. 6:—The frequencies are (6/5); 6/4; 6/3; 6/2; 6/1.

Do. 7:—The frequencies are (7/6); (7/5); (7/4); 7/3; 7/2 and 7.

Do. 8:—The frequencies are (8/7); 8/6; (8/5); 8/4; 8/3; 8/2 and 8.

Do. 9:—The frequencies are (9/8); (9/7); 9/6; (9/5); 9/4; 9/3; 9/2 and 9.

Do. 10:—The frequencies are (10/9); 10/8; (10/7); 10/6; 10/5; 10/4; 10/3; 10/2 and 10.

Some of these can be recognised from Tables I and II and the figure 11, and we need concern ourselves only with values between 1 and 4.

Taking the values lying between frequencies 1 and 2; i.e., in the 1st octave, and omitting repeated ratios, we have 1 Shadja; 10/9 Trisruti Ri; 9/8 Chatusruti Ri;

8/7; 7/6 septimal third (ga_1); 6/5 Sadharana gandhara, Minor third (ga_2); 5/4 Antargata Gandhara (Ga_1). 9/7 Tivra Gandhara; 4/3 Suddha Madhyama (Ma_1); 7/5 Prati madhyama; 10/7 Tivratara madhyama; 3/2 Panchama; 8/5 Suddha dhaivata (da_2); 5/3 Trisruti Da (Da_1); 7/4 septimal ni (ni_1) and 9/5 Kaisika nishada (ni_2).

I must take this opportunity to point out the *incorrect* statement that the Vina is "tuned to equal temperament" as the piano, made by captain C. R. Day in his book, "The music and musical instruments of Southern India and the Daccan", at Page 32, since upper partials can be heard at the frets marked U. P. in figure 11 in Vinas properly tuned, as in Tanjore.

Characteristic Srutis.	Sa	Ri_2	Ga_1	Ma_1	Pa	Da_2	Ni_1	Sa
Probable Frequencies.	1	9/8 or 10/9	5/4 or 9/7 or 81/64	4/3	3/2	5/8 or 27/16	15/8 or 27/14 or 243/128	2

In actual violin practice, Ri and Da are generally played Ga Ri and Ni Da respectively, the higher notes being touched first. There is a meaning in this. It is easy for the throat to get to Ri 9/8 from Pa and not from Sa. Sa Ga being a 5/4 relationship, we get to Ri from Ga. Further, these notes Ri and Da do not seem to be steady and cannot be linaka Swaras *i.e.*, without Gamaka, without detriment to the Bhava of this Raga. The alternate swaras Ri, Ma and Da are all in Gamaka and oscillating when elongated. There is peculiar prayoga as Sa Da, Pa in this melody. Again Ni is sometimes played as Ni_2 *e.g.* | Sa Ni Sa | Dha Ni Sa Ri | Ga Ri Sa Ni, Sa Ri | The first two Ni's are Ni_1 (Kakali Nishada) while the third is Ni_2 (Tivra Nishada), higher than Ni_1 but in Gamaka; Kurunji Raga has also this Ni_2 in when it ends in that note in Gamaka.

To my knowledge, the Raga *vistara* (spread or expansion) is made only from Sa Ga and Pa and occasionally Ni. This harmonic Ni 15/8 is reached in the phrase *Sa Dha Ni, Sa* with effort. At the three swaras Sa Ga Pa the throat stops a long while, and the notes are elongated to some length of time. In the case of other swaras, there is generally always gamaka *e.g.*, in

Ri , , Ga Ri Sa Sa, Ni , , | Ni is shadja sambandha with gamaka. Similarly *e.g.*, in | Dha Ni, Sa | Sa Da, Pa | Ni is Ni$_1$ and the first Da is Ni sambandha.

This does not mean that Ri$_1$ and Da$_1$ do not appear at all in the raga. In Sa Ri, Sa for instance, the Ri is Ri$_1$ but in gamaka goes even up to Ri$_2$ or a little higher.

In a janya raga "Kannada" in the melody (Kriti) "Enthakante Kavalana" the song begins this Sa Ma Ga Ma , , Ma Da Pa Da. The first Da is 5/3 (Trisruti) and the second is 27/16 Chatusruti. It is seen as a grace movement from Da$_1$ (5/3). I have also noticed one instance of Trisruti Da$_1$ (5/3) in the annupallavi of the song 'Muthukumaraiyane' of the composer Guhadasa in Sankarabharana rendered into notation | Ma, Da Da, Pa Ma Ga | "Rathi yothi yodu" | Ma Da has a 5/4 relationship and it is thus sought to emphasise the relationship 5/4 characteristic in this raga.

II. Harikambodi, Mela 28.

Venkatamakhi Scale.—	Sa	Ri	Ga	Ma	Pa	Da	ni	Sa
Characteristic Srutis	Sa	Ri$_1$	Ga$_1$	Ma$_1$	Pa	Da$_1$	ni$_1$	Ṡa
Possible frequencies	1,	10/9 or 9/8	5/4 or 81/64 (?) or 9/7	4/3	3/2	5/3 or 27/16	7/4 or 16/9 (?) or 9/5	2

I shall write in detail about the most commonly sung Janya raga of this root raga, *Kambodi* (Sa Ri Ga Ma

Pa Da Ṡa, Ṡa ni Da Pa Ma Ga Ri Sa) with special prayogas Ma Ga Pa Da Sa and an occasional Sa Ni Pa- apparently to have symmetry with Ma Ga Sa. In this raga, the first prayoga to be noticed is Ri , , , Pa Ma Ga. Here Ri is Ri_2 (Chatur Ri) since the ratio Pa to Ri is 4/3; but this is in gamaka. Another important feature is that Da_1 can be elongated to any number of matras in time *e.g.*, in varnam taruni' the swaras sung are Da , , , , , ni Pa Da ni ni Da etc. The important feature being Da_1. the Ri should *not* be linaka at all, as Ri_2 is a stronger note heard in relation to Pa of the drone. Hence it is 5/3 (Trisruti Da). Hence the concordance noticed with Sa, which is *not the case with* Da_2 *of Sankarabharana.* To balance the raga, the music stands also at Ga_1 for a short while. Also notice the prayoga Da Ma Da , , , since Da=5/4 of 4/3. In the phrase | Da Sa | Da Ri, Ri | Ri_1 should be used. Dha (27/16) rarely occurs at all. The prayoga Ma ni and ni Ma in this, as well as in Malavi, a janya raga, where this is an important feature, *may* justify the use of 16/9; but I think 7/4 is more commonly used when elongated, as in Surati. ni is either very short or is generally in gamaka in this raga. The notes, which we generally expand Kambodi raga from, are, to my knowledge, Sa Ga Pa Da. These have values 1, 5/4, 3/2, 5/3, Ri Ma ni, all being in gamaka, when elongated.

Kalyani. Venkatamakhi Scale.

Sa Ri Ga ma Pa Da Ni Ṡa

The characteristic srutis are :—

Sa Ri_2 Ga_2 ma_2 Pa Da_2 Ni_2 Sa

Possible frequencies are

1	10/9	5/4	7/5	3/2	5/3	15/8	2
	9/8	81/64(?)	45/32(?)		27/16	$\frac{243}{128}$(?)	
		or	or			or	
		9/7	10/7			27/14	

The stopping places and the linaka notes are Sa Pa and Chatursruti Ri; the Andola and Kampita Gamakas are noticeable in all the swaras (excepting Sa and Pa) and even in Ri. One may ask whether Ri$_1$ (Trisruti Ri), Ga$_1$ (Antaragata Ga), Da$_1$ (Trisruti Da) do not appear at all. They are noticeable especially in descent, and when the panchama is discarded in the phraseology, but we rarely indeed play Ga together with Pa the open string, and I don't at all. In Pa ma Pa, the ma is sharper. But in descent ma is generally softer. The fall |Pa Ri| is more in vogue than |ma Ri| in this raga in the major compositions.

Kharaharapriya. Venkatamakhi Scale.

Sa Ri ga Ma Pa Da ni Ṡa

The characteristic srutis as found in to-day's music are:—

Sa Ri$_2$ ga$_2$ Ma$_1$ Pa Da$_2$ ni$_2$ Sa

This raga seems to have itself undergone transformation. In the earlier compositions of Thiagaraja, Ri is Trisruti, gandhara is Madhya gandhara and Da Trisruti and ni Madhya nishada. See 'Korisevimparada' starting - Pa, Da ni Da, ni etc.

The possible frequencies are

1	10/9	7/6	4/3	3/2	5/3	7/4	2
	or	or			or	or	
	9/8	6/5			27/16	16/9	
						or	
		32/27 (?)				9/5	

In 'Pakkala nilabadi', a later composition of that composer, the change seems to have been made so as to distinguish it from Bhairavi at certain places; the stopping places are Sa Pa and Ri, the rest in Kampita or Andola gamaka. In the Anupallavi of 'Chakkani Raja' the piece itself starts with Da (5/3), vide word chi of Chikkani palu.

BHAIRAVI. Venkatamakhi Scale

Sa Ri ga Ma Pa da ni Sa
or
Da

The characteristic srutis are :—

Sa Ri_1 ga_1 Ma Pa Da_1 ni_1 Sa
(& da_1 in descent)

The phrases Sa Ri ga Ma and Pa da ni da are permitted.

Possible frequencies

1	10/9	7/6	4/3	3/2	5/3	7/4	
	9/8	6/5				16/9	
		32/27(?)			27/16(?)	9/5	2

and in descent da 8/5, or 14/9

The phrase Ma ni da Pa rules the raga. In this phrase the ni has sometimes to be Madhyama of Madhyama *i.e.* 16/9; again ga is always weak, and is seen probably to be 7/6, especially when we say sa ga ri ga. Ri is 10/9. The stopping places are Sa Pa and Ma only.

My ruse, so as not to lose the raga bhava, is to fix my mind on Ri_1 and Da_1 in Bhairavi; while in Kharaharapriya I hold on to Ri_2 (9/8) Chatursruti and ni_2 9/5 (Kaisikanishada) and naturally the swara Da_2 gets therefore raised to 27/16. in play.

HANUMATHODI,

Swaras. Sa ri ga Ma Pa da ni Sa (Generally in ascent in playing, ni is Sa ni, ga is Ma ga.

Characteristic srutis. Sa ri_1 ga_1 Ma Pa da_1 ni_1 Sa

Possible frequencies.

1	21/20	7/6	4/3	3/2	14/9	16/9(?)	2
	or	or			or	or	
	16/15	6/5			8/5	9/5	
		or			63/40	or	
		32/27 (?)				7/4	

The Symmetry in Sa Pa strings is not affected by Sa ri_2 g_2 Ma Pa da_2 ni_2 Sa and yet the South Indian delights largely in the flatter notes of ri_1 ga_1 da_1 and ni_1

The stopping places Sa Pa and Ma and da_2 are notes where the voice stops very frequently. Pa is occasionally omitted in ascent and when Ma da ni Sa is

stressed, ni becomes ni_1. All the notes ri ga da and ni seem to fall by a small interval as the occasion may require in the Kampita gamaka and the Andolika gamaka. The da and ri are occasionally seen on vina play by a pull from below the head of Pa and Sa strings: also ga_1 is produced from Ri fret.

Again ni_2 in ascent from da_1 is *as far as possible* avoided, so as not to confuse this with the raga Hindola or Hindustani malkons having swaras

|Sa ga Ma da ni Sa| Sa ni da Ma ga Sa In Hindola ga becomes ga_2, and so the ni also raises itself to ni_2.

CHAPTER IX.

RAGAS KANAKANGI AND CHALA NATA

In the six ragas we have been considering, the intervals Sa Ma - Pa Sa - and Ri_2 Pa - are Suddha Madhyama intervals. This interval consists of one major tone, one minor tone and one semi tone or mathematically 4/3= 9/8x10/9x16/15. These three intervals are distributed in the orders possible between Sa Ma and Pa Sa in the five Suddha Madhyama ragas and between Ri and Pa in Kalyani raga.

In the other ragas of South India, that is in the other scales, an attempt is made to have a larger interval than a major tone. One such interval is 6/5. So 4/3 can be made up of, as follows:—6/5×25/24×16/15. Any order

of these three ratios can be thought of between Sa and Ma, and similarly Pa and Ṡa, and Ri_2 and Pa.

7/6 is also a ratio, which is just lower than 6/5, but we shall leave that for the present.

Let us now consider two typical ragas of Kanakangi the first mela and Chalanata, the last mela of the 36 Suddha Madhyama melas, or types.

Kanakangi	Sa	Ri	(ga)	Ma	Pa	da	(ni)	Sa
Rel. Fre.	1	25/24	10/9	4/3	3/2	25/16	5/3	2

One can ask whether the two ratios of 25/24 and 10/9 can be pronounced consecutively. Yes, it is just possible with a slight break in the continuity, and similarly, the ratios of 25/16 and 5/3; it is however avoided and the phrasing generally takes such as the following groups | (ni) Sa ri | (ga) Ma Pa. By such phrasing a delightful effect is produced and this has been exploited on.

Chalanata.

Swaras.	Sa	(Ri)	Ga	Ma	Pa	(Da)	Ni	Ṡa
Rel. Fre.	1	6/5	5/4	4/3	3/2	9/5	15/8	2

Even in the major composition of Thiagaraja. *Jagādānda* in raga Nāta the phrase Sa (Ri) Ga Ma occurs barely three, or four times. The music, somehow or other, steps off to Ga Ma Pa in the ascent and to Pa Ma (Ri) in the descent. The phrase Pa (Da) Ni is absent in that composition.

I may however add that the swaras and the pronunciation of (ga) and (ni) and of (Ri) and (Da) in the two ragas above at the proper pitches are resorted to only

in swara singing, but as pure vowel sounds, there is absolutely no difficulty if one can grasp them. In Natai, a janya raga of Chalanata with swaras Sa Ga Ma Pa Ni Sa in ascent and Sa Ni Pa Ma (Ri) Sa in descent, it is seen that the dodge of pronouncing Ga as a gamaka from Ma is generally followed and the gamaka is sharp so as to raise the pitch of Ga to only 70 cents probably, from Ma. The possibility, therefore, of the 70 cents appearing arises most in ragas where the distance or the interval between the successive notes is raised to that of a minor third, (harmonic). Again, the interval of 7/6, the septimal minor third from Sa is also another feature which can occur very much in Prati Madhyama ragas, as for instance, in Subha Pantu varali, when the raga takes the twist Sa ga ri ga.

I may close this chapter with some examples as to how we can intellectually conceive what srutis ought *not* to come in at all, when the juxtaposition in the ordinary swaras of the raga has been given.

Let us consider Abhogi (in mela 22)

|Sa Ri ga Ma Da Ṡa| Ṡa Da Ma ga Ri Sa|

ni is varjya (absent) as also Pa

The possible ratios are:—

1	10/9	32/27 or 7/6	4/3	5/3	2
Sa	Ri_1	ga_1	Ma_1	Da_1	Ṡa

Ṣwara Ri is Trisruti Ri and is the same in descent. Surely $Ri_2 = 9/8$ should not come in - being the fifth of Panchama which does not appear in the music, and it

would be un-aesthetic to elongate it 'linaka', as the swara would be unconsciously raised to Ri_2 when we play the note straight in Pa steel string, further Da being (Trisruti) associated and coming next to *Ma.*

Sriranjani.

Sa Ri ga Ma Da ni Ṡa Ṡa ni Da Ma ga Ri Sa

Owing to the absence Pa and the prominence of Ma, the same argument as stated in Abhogi will apply. Da will be ordinarily Trisruti as also Ri and in fact, Thiagaraja uses in the melody Ma Ri_1 ga always whenever possible.

CHAPTER X.

RHYTHM OR TALA.

In Indian music, Rhythm or Tala may be said to be the summation of units of time (Kāla). Some kritis are in *tsavuka* (elongated) time measure, while some are in Madhyamakala or ordinary measure.

Leaving aside complicated time measures, the greatest musical compositions of South India are only in 4 tala types, which can be represented by the numbers 8, 7, 6, and 5 as units of time, commonly named the *Adi* tala, *Chapu* or *Triputa* tala, *Rupaka* tala and *Jampa* tala respectively, and the music goes on in such cycles.

The number 8 may be said to be equal to

4+2+2. Ex. Sa ri Ga Ma| Pa da| Ni Sa
or 2+2+2+2.

The number 7=4+3 or 3+4 Ex. Sa ri Ga| Sa ri | Ga Ma|
or 3+2+2.

The number 6=2+4 Ex. Sa ri| Sa ri Ga Ma|
or 2+2+2.

The number 5=2+3. Ex. Sa ri| Sa ri Ga|
or 3+2.

The above units (the technical word is akshara) may be doubled if necessary, as 16, 14, 12 and 10. If we do so, there is no change in the method of summation, of the numbers 16 and 12 which are just double in each case, while there exists a difference in the summation in numbers 14 and 10.

14=5+5+2+2 Ex. Sa ri, Ga,| Sa, ri Ga,| Ma,| Ma,| or Aṭa tala.

or 14=4+2+4+4 Ex. Sa ri Ga Ma| Ga ri| Sa ri Ga ri| Sa ri Ga Ma| or Dhruva Tala.

10=7+1+2 Ex.| Sa ri Ga Sa ri Sa ri| Ga| Ma, Jampa Tala.

or 10=4+2+4 Ex.| Sa ri Ga ri| Sa ri| Sa ri Ga Ma| Maṭya Tala.

The next question to ask ourselves is 'where are the stresses and strains', as it were, in these time measures? In South Indian music, the rhythm in the music of a singer is represented by a beat (to produce a sound) and finger counts, [the counting by fingers after taking the beat as no. 1, is done as 2, 3, 4, 5, 6, 7 as may be needed, by the little finger, for the second; the ring finger, for the third; the middle finger, for the fourth unit, the index finger for the fifth; the thumb for the sixth; and the little finger for the seventh (without a beat)], or by a beat and a throw of the hand, or by a beat alone.

(The technical name for beat and count is *laghu*

" " beat and throw is Dritam.

" " beat alone anudṛita)

I *Time measure of* 8 *units.*

If summed as 4+2+2, the beats, counts and throws are as below.

Beat 3 Counts	Beat Throw	Beat Throw
1+1+1+1	1+1	1+1

and similar repetitions.

If summed as 2+2+2+2, it is really taken as

Beat beat beat throw

1+1+1+1 (i.e., 3 beats and 1 throw for each quarter of the whole time measure

II. (*a*) *Time measure 7 units.* We may sum up as 3+4 or 4+3 or 3+2+2.

Case 3+4; | 1 beat+1+1 | 1 beat+1+1+1 |

Case 4+3; | 1 beat+1+1+1 | 1 beat+1+1 |

There may be no counting here at all in both the above cases.

We have case 3+2+2 | 1 beat+2 counts | 1 beat+1 throw and | 1 beat+1 throw |

II. (*b*) 7 units may be doubled as 14.

Case 14=5+5+2+2; we have then

| 1 beat+4 counts | 1 beat+4 counts | 1 beat+1 throw | 1 beat+1 throw |

II. (*c*) Case 14=4+2+4+4; we have then.

| 1 beat+3 counts | 1 beat+1 throw | 1 beat+3 counts | 1 beat+3 counts |

III. *Time measure of* 6.

Case 6=2+4; we have | 1 beat+1 throw | 1 beat+3 counts |

Case 6=2+2+2, the three measures are treated as equal, and we have | 1 beat+1 beat+1 throw |

IV. (*a*) *Time measure* 5; we have

Case 5=2+3 | 1 beat+1 throw | 1 beat+2 counts |

IV. (*b*) If the measure is doubled as 10, we may treat

10=7+1+2, we have then

| 1 beat+6 counts | 1 beat | 1 beat+1 throw |

IV. (*c*) or 10=4+2+4; we have then

| 1 beat+3 counts | 1 beat+1 throw | 1 beat+3 counts |

The next question is, where does the music begin, at the first beat or elsewhere?

Regarding the 8 units time measure, there are 5 ways. This music of 8 units is generally written in 32 sub units.

| 1st unit | 2nd Unit | 3rd Unit |

| 1 2 3 4 | 1 2 3 4 | 1 2 3 4 | and so on.

$\overset{1}{@}$ $\overset{3}{@}$ $\overset{4}{@}$ | $\overset{1}{@}$ $\overset{3}{@}$

(*a*) We can start music at 1/1 or at 1/3 or at 1/4, vide sign @, the numerator showing the unit and the denominator showing the sub unit measure at which the music may start. That is, at the commencement itself of the beat or leaving off either *two or three sub units* of the 32 units. The beat is always at 1/1 where the music joins later.

(*b*) Or it may start even at the commencement of the second unit that is, at 2/1 or it may even commence at 2/3. In the last two cases, we can consider as if the whole time measure is divided into 16 sub units and that the music commences after leaving off 2 or 3 of the 16 sub units, of course joining up later again.

Regarding the 7 *akshara* measure, the music may start with the beat in the summation 3 + 4 or 4 + 3. See page 88. Or at the sign @ as below.

@
| 1 beat + 1 + 1 | + 2 | + 2 |
or | 2 + $\underset{2}{@}$ | + 3 |

When the measure is 14 units, the music may start at the 1st beat or at the sign @ | 2 + $\underset{3}{@}$ | 5 | 2 | 2, that is after leaving 2 aksharas out of the 14, the music starting with the ring finger where the count begins, and joining up, of course at the beat of the first matra.

Regarding the time measure 6, the music may also start at the throw or at the second beat itself, vide sign @ | 1 + 1 | $\underset{1}{@}$ + 1 + 1 + 1 |

Regarding the five unit measure the music may start elsewhere than at the beat thus, vide sign @ | 1 + $\underset{1}{@}$ 1 beat + 1 + 1 |

Examples of each case of the above are given in the appendix. The notation in the following pages will certainly in my opinion serve the purpose of an All-India Notation for music.

8 MATRAS MEASURE.

Raga Sankarabharana

case | 1 2 | 3 4 |
1 | Pa, Ma, Pa,, Ma | Ga Ma Pa Ma Ma Ga Ga Ri |
| Ma ri ya | da |
| 5 6 7 8 |
| Ri Ga Ri Sa Sa, Sa Ni Sa, Ri,, Ga, Ma |
| ga du ra |

The music starts at the commencement of the first beat.

Raga Sankarabharana

case | 1 2 3 | 4 |
II | ** Pa,, Ma Pa,, Ma | Ga, Ma Ri Ga, |
Ra ga mu	ta la mu
5 6	7 8
; Ga Ma Pa Ma Ga,	Ri Ga Ma Ga Ga Ri Sa,
Ra kti bha	kti jna na
1
;

The music starts after leaving half of the first unit,

Raga Harikambodhi.

case | 1 2 3 4 |
III | * * * ni Da , , ni Sa , , ni Da ni Sa, , ni Da, |
| En ta ra ni ta na |
| 5 6 7 8 |
| ; Pa, Da Pa Pa Da ni Sa ni, Da Pa Ma, Ga Ma |
| ken te bo ni nee |
1
Pa Da Pa.

The music starts after leaving three-fourths of the first unit.

Raga Begada

case | 1 2 3 4 5 6 7 8
IV | ** Ma,, Ma Ga Ga, Ma, Pa,, Da Pa,| Music written
| ; na do pa sa na | in 16 sub units.

The music starts at the second unit.

Raga Khamaj

Case| 1 2 3 4 5 6 7 8 |
V | *** Ma, Ma Ga Ga Ma Pa,, Ma ni Da ni Da |
| Si ta pa tee na ma na su |
Pa ,, The music written in 16 sub units.
na

The music starts leaving off the first unit and a half of the 2nd unit.

Notice in the last case that the 2nd half of the whole measure will start generally with 3 sub units of the 16 sub units.

Seven Matras measure [*Raga Ritigaula* 7=3+4.]

| 1 4 | 1 4 | 1 4 |
I | ṇi ṇi, Sa, ṇi, | ga Ri, Sa, ; | ; , ; Sa ṇi |
ja na nee nin | nu vi na | tri |
1 4 |
Ḍa ṇi Sa ṇi Ḍa Ṃa, |
lo ka |

The music starts at the first unit of the group of three units.

Raga Purva-Kalyani here 7=4+3.

| 1 5 | 1 5 | 1 5 | 1 5 |
II | Sa, Da, Sa Sa, | ; Da, Sa ri, | Ga, ri, Ga Ga, | ; ri ,, Sa|
| ni nu vi na | ga ma ri | di ke va ru | •na |

The music starts at the first unit of the group of four units.

Raga Kharaharapriya here 4=3+2+2.

III	1	2	3	4	5	6		7		
	, ,	Pa,	Da,	ni,	, ,	ni	Da	Da	Pa	
		pa		ka		la				

1					4				6	
Sa	, ,	Sa	ni	ni,	ni	Da	Da	Pa	Pa Ma	Ma, ;
ni		lu			ba				di	

Written in 14 sub units to avoid showing lines over the swaras. The music starts leaving off one unit of the group of three.

In repeating the tune we change thus.—

1	4	6
; ; Pa,	Da, ni,	ni Da Da Pa etc.
pa	ka	la

The music joining, leaving off 2 units of the group of three.

Raga Lalita (according to Shyama Sastri) 7=4+3.

IV	1 5	1 5	1 5	
	; Ma, Ga Ma,	Da, Da, Ni Ni,	Sa, ; Ni Da,	
	Nan nu	bro va la li	ta	
				1 5
				; Da Ni Da Ma,
				ve ga me

1 5
; Ga, Ma ;
nan nu

The music starts leaving off 2 units of the group of four units.

14 Units here 14=5+5+2+2.

Written as 56 sub units)

Music starts, leaving off 2 units (out of 14), from the first group of five units and joins later.

```
1    2        3      4            5
* * * * * * * * * Ma, Ma, da Pa da Ma Pa ga Ma,
                  chi  ru nau
1    2        3            4          5
Pa, ; Pa, ;   Ma Pa  ni  ni da Pa Ma ga Ma ni Da Pa
voo
     | 1          2         | 1         2        |
     | Ma ga Ri ga Ma Pa da Ma | Pa Ma da, Pa, Ma Pa|
                      mu    | na
     1          2           |
     Sa ni da Pa   Ma ga Ri ga |
```

Ata Tala (14 Units) Vasanta Raga.

```
| 1          2  | 3          | 4          | 5
| Ma Ga Ma, Da, ; | Sa Ni Da Ma | Sa Ni Sa ri | Sa, ;
| Na     ta    nam | ā          |         di | nar
   6 |        | 7       8          9
   ; | Sa Ni  | Sa, ri Sa, Ni Da Ma Da Ni Sa Ni
     | ve hu  | na  ga ree  ga ma    ha  ve  ka na
                                         10
                                         Da Ma Ma  Ma
                                         ka sa  bhai yil
11           12          13          14
Sa Ni Da Ni  Da Ma       Ma, ; Ga ri   Ga ri Sa Ni
A                        naṃ           da
```

The music starts at the commencement.

6 Unit Measure 6=2+2+2.

Rupaka. *Raga Maya Malava Gaula.*

```
  1  2        3      1           2  3  o
I Ni da Pa , , Ma Ga Ma Pa da Pa Ma Ga, Ri Sa Ṇi
  Tu la see       da la mu    la     che sa   m
```

1 2 3 1 2 3
Sa ri Ga Ga Ga, Ga Ma Pa Pa Ma Ga Ma
tho sha mu ga poo ji ntu

The music starts at the commencement,

Raga Maya Malava Gaula here 6=2+4
music written in 12 sub-units.

1 2 3 1 2 3
II ,, da Pa Ma Ga Ma, Pa, da, Pa,; Pa, da Ni da Pa
1 san ta ta mu ci va sma ra na va
da Ma

The music starts, after leaving half of the first unit.

Kalyani

1 2 3 1 2 | 3 | 1 2 3 1 |
III ,, Ri Sa, Sa Ri Ri, | Ga, ma | Pa, ; Pa ma Ga Ri |
bhi ra na va ra | lee chi | bro – vu mu ni nu |
2 3
Pa ma Ga,
ne ra nam

1 |
Ri Sa |
mi ti |

Music written in 6 units; Music starts with the 2nd beat or the beginning of the group of 4 units.

Sankarabharana.

Here 6 units=2+2+2; music written in 12 sub-units.
beat beat throw
2
| 1 (Ga) | (Ga) | 3 |
* * * Ma | Ga Ri Sa Ri | Ri Ga, Ma | Ga ,, |
mu | du —— Ku | ma rai ya | ne |

an odd case, the music starting just one sub-unit before the first beat.

or the music may be considered alternatively as commencing at $\frac{1}{2}$ the throw, (lying in the first portion which starts with a beat and a throw) the word of the melody 'du', being the commencement of a beat and 3 counts.

3 4 5 6 1 2
Ma | Ga Ri Sa Ri Ri Ga, Ma | Ga ,, here 6=2+4
Mu du ku Ma rei ya ne

Jhampa Tala, 5 Units (written as 10 sub-units.

Madhyamavati.

I 1 2 3 4 5 1 2 3 4 5
ni, ; Sa, Ri, ; Ri, Ri, Pa Ma Ri Sa Ri,
na du pai Pa li ke ru
1 2 3 4 5 1 2 3 4 5
Ri , , Ma Ri , , Ma Ri, ; Sa, Sa , , Ri Ri Sa ni, Pa,
na ru lu sri Ra ma

The music starts at the commencement of Tala.

Jhampa of 10 units.

Sarangā.

Beat ←——6 counts——→ Beat Beat Throw
II (*a*) 1 2 3 4 5 6 7 8 9 10
, Pa Pa , Pa Pa ma ma ga ma Pa Pa
nee va — da ne — ga — ma
1
,
II (*b*) 1 2 1 2 3 1 2 1 2 3
, Pa Pa , Pa Pa ma ma Ga ma Pa Pa
nee va da ne ga — na
1
, The music starts leaving off 1 unit.

CHAPTER XI.

MELA RAGAS OR SCALES OR MELODY TYPES.

I Chakra - Swaras

	Names*	1	2	3	4	5	6	7	8	9	10	11	12	13
1.	Kanakangi	Sa	ri	(ga)	*	*	Ma	*	Pa	da	(ni)	*	*	Ṡa
2.	Ratnangi	Sa	ri	(ga)	*	*	Ma	*	Pa	da	*	ni	*	Sa
3.	Ganamurthi	Sa	ri	(ga)	*	*	Ma	*	Pa	da	*	*	Ni	Sa
4.	Vanaspati	Sa	ri	(ga)	*	*	Ma	*	Pa	*	Da	ni	*	Sa
5.	Manavathi	Sa	ri	(ga)	*	*	Ma	*	Pa	*	Da	*	Ni	Sa
6.	Thanarupi	Sa	ri	(ga)	*	*	Ma	*	Pa	*	*	(Da)	Ni	Sa

II Chakra - Swaras.

	Name.	1	2	3	4	5	6	7	8	9	10	11	12	13
7.	Senapati	Sa	ri	*	ga	*	Ma	*	Pa	da	(ni)	*	*	Ṡa
8.	Hanumathodi	Sa	ri	*	ga	*	Ma	*	Pa	da	*	ni	*	Sa
9.	Dhenuka	Sa	ri	*	ga	*	Ma	*	Pa	da	*	*	Ni	Sa
10.	Natakapriya	Sa	ri	*	ga	*	Ma	*	Pa	*	Da	ni	*	Sa
11.	Kokilapriya	Sa	ri	*	ga	*	Ma	*	Pa	*	Da	*	Ni	Sa
12.	Rupavati	Sa	ri	*	ga	*	Ma	*	Pa	*	*	(Da)	Ni	Sa

*The names as used in the composition 'Mela Raga Malika' of Maha Vaidhyanatha Sivan are given here. In each melodic portion the name of the Mela is given.

III Chakra - Swaras

	Name	1	2	3	4	5	6	7	8	9	10	11	12	13
13.	Gayakapriya	Sa	ri	*	*	Ga	Ma	*	Pa	da	(ni)	*	*	Ṡa
14.	Bakulabharana	Sa	ri	*	*	Ga	Ma	*	Pa	da	*	ni	*	Sa
15.	Mayamalavagaula	Sa	ri	*	*	Ga	Ma	*	Pa	da	*	*	Ni	Sa
16.	Chakravaka	Sa	ri	*	*	Ga	Ma	*	Pa	*	Da	ni	*	Sa
17.	Suryakanta	Sa	ri	*	*	Ga	Ma	*	Pa	*	Da	*	Ni	Sa
18.	Hatakambari	Sa	ri	*	*	Ga	Ma	*	Pa	*	*	(Da)	Ni	Sa

IV Chakra - Swaras

	Name	1	2	3	4	5	6	7	8	9	10	11	12	13
19.	Jhamkaradhwani	Sa	*	Ri	ga	*	Ma	*	Pa	da	(ni)	*	*	Ṡa
20.	Natabhairavi	Sa	*	Ri	ga	*	Ma	*	Pa	da	*	ni	*	Sa
21.	Kiravani	Sa	*	Ri	ga	*	Ma	*	Pa	da	*	*	Ni	Sa
22.	Kharaharapriya	Sa	*	Ri	ga	*	Ma	*	Pa	*	Da	ni	*	Sa
23.	Gourimanohari	Sa	*	Ri	ga	*	Ma	*	Pa	*	Da	*	Ni	Sa
24.	Varunapriya	Sa	*	Ri	ga	*	Ma	*	Pa	n	*	(Da)	Ni	Sa

V Chakra - Swaras

	Name	1	2	3	4	5	6	7	8	9	10	11	12	13
25.	Mararanjani	Sa	*	Ri	*	Ga	Ma	*	Pa	da	(ni)	*	*	Ṡa
26.	Charukesi	Sa	*	Ri	*	Ga	Ma	*	Pa	da	*	ni	*	Sa
27.	Sarasangi	Sa	*	Ri	*	Ga	Ma	*	Pa	da	*	*	Ni	Sa
28.	Harikambodhi	Sa	*	Ri	*	Ga	Ma	*	Pa	*	Da	ni	*	Sa
29.	Dhira Sankara bharna	Sa	*	Ri	*	Ga	Ma	*	Pa	*	Da	*	Ni	Sa
30.	Naganandini	Sa	*	Ri	*	Ga	Ma	*	Pa	*	*	(Da)	Ni	Sa

VI Chakra - Swaras

	Name	1	2	3	4	5	6	7	8	9	10	11	12	13
31.	Yagapriya	Sa	*	*	(Ri)	Ga	Ma	*	Pa	da	(ni)	*	*	Ṡa
32.	Ragavardhini	Sa	*	*	(Ri)	Ga	Ma	*	Pa	da	*	ni	*	Sa
33.	Gangeyabhushani	Sa	*	*	(Ri)	Ga	Ma	*	Pa	da	*	*	Ni	Sa
34.	Vagadhiswari	Sa	*	*	(Ri)	Ga	Ma	*	Pa	*	Da	ni	*	Sa
35.	Sulini	Sa	*	*	(Ri)	Ga	Ma	*	Pa	*	Da	*	Ni	Sa
36.	Chalanata	Sa	*	*	(Ri)	Ga	Ma	*	Pa	*	*	(Da)	Ni	Sa

As an exception to the *Nota Bena* at Page 3 I may mention that in Swara Singing, Shadsruti Dhaivata | (Da) | is pronounced stressed as Dha at the pitch (9/5) ni_2.

The above six *chakras* (groups) are all of Suddha Madhyama ragas, that is to say, they take only Suddha Madhyama in their melodies. The next 36 ragas are Prati madhyama ragas. They do not take the Suddha Madhyama at all, but take only Prati madhyama. If one substitutes Prati madhyama for Suddha Madhyama in the above six chakras respectively, we get the corresponding ragas of the Prati madhyama chakras, and I give only their names to avoid repetition, as the system of division is clear enough.

VII Chakra.

37. Salaga.
38. Jalarnavam.
39. Jalavarali.
40. Navanitham.
41. Pavani.
42. Raghupriya.

VIII Chakra.

43. Gavambodhi.
44. Bhavapriya.
45. Subhapantuvarali.
46. Shadvidhamargini.
47. Suvarnangi.
48. Divyamani.

IX Chakra.

49. Dhavalambari.
50. Namanarayani.
51. Kamavardhini.
52. Ramapriya.
53. Gamansrama.
54. Visvambhari.

X Chakra.

55. Syamalangi.
56. Shanmugapriya.
57. Simhendra madhyama.
58. Haimavati.
59. Dharmavati.
60. Nitimathi.

XI Chakra.

61. Kantamani.
62. Rishabapriya.
63. Latangi.
64. Vachaspati.
65. Mechakalyani.
66. Chitrambari.

XII Chakra.

67. Sucharitra.
68. Jothiswarupini.
69. Datuvardhini.
70. Nasikabhushani.
71. Kosala.
72. Rasikapriya.

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CHAPTER XII.
JANYA RAGAS.

The best way of understanding the Bhava of a janya raga is to record its *Sanchara* or the order of aroha and avaroha Swaras of the Scales in which they can be given a *niche*:

I say this especially because the srutis (or the particular from notes of the swaras) could be casily ascertained with reference to Sa, Ma and Pa, so as to maintain as far as possible a musical interval between successive swaras. Of course, some few ragas can be given a niche in one or more of the Melakarta ragas, but as long one know what Swaras we use, we need not worry much on the score of the scale.

A list of the more important janya ragas, in which has been successfully achieved a *totality of aesthetic effect* in modern Raga alapana, is given below. Some Vernacular books have given the mere Sancharakrama that I first felt it needless to copy them. I however propose to add a remarks column to show the Visesha (special) Sancharas of these ragas and the non-permissible Swara combinations, which should be avoided, so as not to cause confusion of raga Bhava with allied ragas.

The Music Academy, Madras has published a pamphlet, in English, of ragas, wherein raga lakshanas are given as they were discussed in the proceedings of several years. A selection therefrom, has been rearranged by me, according to melakartas with my own remarks and observations, as the said pamphlet is some times too *laconic* in characterisation.

Hanumathodi, Mela 8.

1. Dhanyasi.

Ar. Sa ga Ma Pa ni Ṡa

Av. Sa ni da Pa Ma ga ri Sa

Phrases Sa ri ga ri and Pa da ni da are not permissible.

2. Punnagavarali.

Ar. ṇi Sa ri ga Ma Pa da ni,

Av. ni da, Pa Ma ga, ri Sa ṇi

Higher Sa is not reached in this raga. It more often takes Ri_1 in ascent and in the phrase ga Ri ga. In descent it is always ri.

3. Asaveri.

Ar. Sa ri Ma Pa da Ṡa

Av. Ṡa ni Sa Pa da Pa Ma ga, ri Sa

The ragas takes Ri_1 occasionally in ascent and Pa da ni da Pa is permissible.

4. Hindola.

Ar. Sa ga Ma ni da ni Ṡa

Av. Ṡa ni da Ma ga Sa

Ps is Varjya, absent.

Mayamalava Gaula, Mela 15.

1. Saveri.

Ar. Sa ri Ma Pa da Ṡa

Av. Ṡa Ni da Pa Ma Ga ri Sa

Phrases Sa ri ga Ma and Pa da Ni Sa are not permissible.

2. Nadanamakriya.

Ar. Ṇi Sa ri Ga Ma Pa da Ni

Av. da Pa Ma Ga ri Sa Ṇi

Special feature Sa ri Ma, Ga ri Ma Ma.

3. Gaula.

Ar. Sa ri Ma Pa Ni, Ṡa

Av. Ṡa Ni Pa Ma Ga Ma ri, Sa

ri and Ni are moorchana Swaras. ri Ga Ma ri Sa a special feature.

4. Gauli Pantu.

Ar. Sa ri Ma, Pa Ni, Sa

Av. Sa Ni da Pa Ma Pa da Ma Ga ri, Sa

ri and Ni are moorchana Swaras and are in Gamaka when elongated.

5. Bhauli.

Ar. Sa ri Ga Pa da Ṡa

Av. Ṡa Ni da Pa Ga, ri Sa

Sa Ni is really played as Sa Sa with the back ground of Ni.

6. Revagupti.

Ar. Sa ri Ga Pa da Ṡa

Av. Ṡa da Pa Ga ri Sa.

7. Pharaz.

Ar. Sa Ga Ma da, Ni Ṡa

Av. Ṡa Ni da Ma Ga Ma Pa da Pa Ma Ga ri Sa

In one of the Kritis of Shyama Sastri, Nilāya Tākshi, Pa has been entirely omitted, except for one instance.

8. Vasanta.

Ar. Sa Ga Ma da Ni Ṡa

Av. Ṡa Ni da Ma Ga ri sa.

Pa is varjya (absent).

Nata Bhairavi, Mela No. 20.

1. Bhairavi has been dealt with in Chapter VIII.
2. Suddha Dhanyasi.

Ar. Sa ga Ma Pa ni Ṡa

Av. Ṡa ni Pa Ma ga Sa.

3. Madhyamavati.

Ar. Sa Ri Ma Pa ni Ṡa

Av. Ṡa ni Pa Ma Ri Sa.

4. Manji.

Ar. Sa Ri ga Ma Pa da ni Ṡa

Av. Ṡa ni da Pa Ma Pa ga, Ri Sa

use of Da in ascent is alike Bhairavi. The phrase ga Pa is common and ga is long: *There is an elusive difference* between Bhairavi and Manji, in the matter of Bhava.

Karaharapriya Mela 22.

1. Sriranjani.

Ar. Sa Ri ga Ma Da, ni Sa

Av. Sa ni Da Ma ga, Ri Sa.

2. Ritigaula.

Ar. Sa ga Ri ga Ma ni ni, Sa

Av. Sa ni Da Ma ga Ma Pa Ma ga Ri Sa ṇi Pa ṇi ṇi Sa. Sa ga ga Ma &

an occasional Pa da Pa are found in all compositions, also Pa Da ni ni Da Ma in Shyamasastri's composition.

3. Sri Raga.

Ar. Sa Ri Ma Pa ni Sa
Av. Sa ni Pa Ma Ri ga Ri Sa

4. Kanada.

Ar. Sa Ri ga, Ma Da ni Sa
Av. Sa ni Pa Da ni Da Pa Ma Pa ga
Ma Ri Sa ṇi Sa Ḍa, ṇi Sa

5. Darbar.

Ar. Sa Ri Ma Pa Da ni Ṡa
Av. Ṡa ni Da Pa Ma ga ga Ri Sa

Special features (1) Da ni Pa (2) Ṡa ni Ṡa Da, Pa (3) Ri ga, Ri Sa, the sound ga gga is perhaps Ri , , Ma Ri , , Ma.

6. Nayaki.

Ar. Sa Ri Ma Pa Da ni, Da Pa Sa
Av. Sa ni, Da Pa Ma Ri ga, Ri Sa

7. Ananda Bhairavi.

Ar. Sa ga, Ri ga Ma Pa Da Pa Sa
Av. Sa ni Da Pa Ma ga Ri Sa

Phrases | Pa da Pa, | Pa ni Sa, | are used. I would however deprecate the recent use of Ga and Ni in this raga.

8. Huseni.

Ar. Sa, Ri ga Ma Pa, Da ni Sa
Av. Sa ni da Pa, Ma ga, Ri Sa

The Raga usually takes the form Sa Pa, Pani Da Ma | Pa ni Da ni Ṡa, | Ṙi Ṡa ni Da Pa Ma, | Pa Da ni Pa da Pa | Ma ga Pa Ma ga Ri Sa |

9. Mukhari,

Ar. Sa Ri Ma Pa ni Da Ṡa

Av. Ṡa ni da Pa Ma ga Ri Sa

Phrase Pa Da Sa is getting common also. Pa ni Da Ma is used.

10. Kaphı.

Ar. Ṇi Sa Ri Ma Pa ni Ṡa

Av. Ṡa ni ni, Da Pa Ma ga ga, Ri Sa.

Also Sa Ri ga Ma Pa Ma ga Ri Sa is used. The use of Ga and da has been copied from Hindustani music.

11. Devamanohari.

Ar. Sa Ri Ma Pa Da ni Ṡa

Av. Ṡa ni Da, ni Pa Ma Ri, Sa.

Hari Kambodi Mela 28.

1. Kambodhi has been dealt with Chapter VIII.

The Sa Sa Pa phrase has become the occasional Sa Ni Pa.

2. Kedaragaula.

Ar. Sa Ri Ma Pa ni Ṡa

Av. Ṡa ni Da Pa Ma Ga Ri Sa.

Phrase Sa Ri Ga Ma is not permissible.

3. Surati.

Ar. Sa Ri Ma Pa ni Da ni Ṡa

Av. Ṡa ni Da Pa Ma Ga Pa Ma Ri, Sa.

An occasional Pa ni ni Sa also is permissible.

4. Yadukula Kambodhi.

Ar. Sa Ri Ma | Ga Ma Pa, Da Ṡa |

Av. Ṡa ni Da Pa Ma Ga Ri, Ma Ga Sa

Also Phrase Ri, Ga Sa in descent is permissible.

5. Khamaś.

Ar. Sa Ma Ga Ma Pa Da ni Sa

Av. Ṙi Ṡa ni Da Pa Ma Ga Ri Sa

Ma is the Moorchana Swara.

6. Mohana.

Ar. Sa Ri Ga Pa Da Ṡa

Av. Ṡa Da Pa Ga Ri Sa

7. Sahana.

Sa Ri, Ga Ma Pa Ma Da, ni Ṡa

Ṡa ni, Da Pa Ma Ga, Ma Ri, Ga Ri Sa

Once in a way Ri Ga Ma Pa Da ni Sa is allowed.

8. Nata Kurunji.

Ar. Sa Ri Ga Ma, ni Da ni Pa Da ni Ṡa

Av. Ṡa ni Da Ma, Ga Ma Pa Ga Ri Sa

Phrases Ga Ma Ga Sa and Sa Ri Ga Ma Pa Ga Ri Sa are permissible.

Sa Ri Ga Ma Pa Da ni Sa is *not* allowed.

9. Senjurati.

Pa Ḍa Sa Ri Ga Ma Pa Da

ni Da Pa Ma Ga Ri Sa ṇi Ḍa Pa

Raga from lower Pa to ni of mid octave, an occasional Sa Ri Ma ga Ri is used.

10. Sama.

Sa Ri Ma Pa Da Sa

Sa Da Pa Ma Ga Ri Sa

Ri, is an oscillating note. The Sancharakrama looks alike Arabhi but there is a difference in Bhava.

11. Balahamsa.

Ar. Sa Ri Ma Pa Da Sa

Av. Sa ni Da Pa Ma Ri Ma Ga Sa

12. Kuntala Varali

| Sa Ma Pa ni Da Ṡa | Ṡa ni Da Pa Ma Sa |

13. Navarasa Kannada.

| Sa Ga Ma Pa Ṡa | Ṡa ni Da Ma Ga Ri Sa |

Mela Sankarabharana 29.

1. Arabhi.

Ar. Sa Ri Ma Pa Da Ṡa

Av. Ṡa Ni Da Pa Ma Ga Ri Sa

The use of Sa Ni Da Pa is very rare and it is mostly Sa Da Pa.

2. Bilahari.

Ar. Sa Ri Ga Pa Da Ṡa

Av. Ṡa Ni Da Pa Ma Ga Ri Sa

An occasional Pa Da ni Da Pa is permitted.

3. Begada.

Ar. Sa Ga Ri Ga Ma Pa Da Pa Ṡa

Av. Sa Ni, Da Pa Ma, Ga Ri Sa

Ma, in descent is oscillating. Ni is Shadja Sambandha (united). *See also* text.

4. Nilāmbari.

Ar. Sa Ri Ga Ma Pa Ni Sa

Av. Sa Ni Pa Da ni Pa MaGa Ma Ri Ma Ga Sa,

Both Ni and ni are used, but mostly Ni gives the raga Bhava.

5. Hamsadhwani.

Ar. Sa Ri Ga Pa Ni Ṡa

Av. Ṡa Ni Pa Ga Ri Sa

6. Suddhasaveri.

Ar. Sa Ri Ma Pa Da Ṡa

Av. Ṡa Da Pa Ma Ri Sa

7. Devagandhari.

Ar. Sa Ri Ma Pa Da Ni Ṡa

Av. Ṡa Ni Da Pa Ma Ga Ri Sa

Sa Ri Ga Ma, Ga Ri is a special feature.
Also Da ni Da Pa where ni is flat.

8. Aṭana.

Ar. Sa Ri Ma Pa Ni Ṡa

Av. Sa Ni Da ni Pa Ma Pa Ga, Ri Sa

Both Ga and Da are oscillating notes in Gamaka. Pa Da ni Da Pa and Sa ni Pa are permissible.

9. Kēdara.

Ar. Sa Ma Ga Ma Pa Ni Ṡa

Av. Ṡa Ni Pa Ma Ga Ma Pa Da Ma Ga, Ri Sa

Phrase Sa Ri Ga, Sa is a special feature.

10. Mohana.

Ar. Sa Ri Ga Pa Da Ṡa

Av. Ṡa Da Pa Ga Ri Sa

11. Kurunji.

Ar. Ṇi Sa Ri Ga Ma Pa Da

Av. Da Pa Ma Ga Ri Sa Ṇi,

The raga extends from Ṇi of lower octave to Da of the mid octave.

12. Bhyahag.

Ar. Sa Ga Ma Pa Sa Ni Ṡa

Av. Ṡa Ni Da Pa ma, Pa, Ga Ma Ga Ri Sa.

Phrase Pa Da ni Pa is used.

13. Kannada.

Ar. Sa Ga Ma Da Ni Ṡa

Av. Ṡa Ni Ṡa Da, Pa Ga Ma Pa Ga Ri Sa

14. Navaroj.

Ar. Pa Ḍa Ṇi Sa Ri Ga Ma Pa Da

Av. Pa Ma Ga Ri Sa Ṇi Ḍa Pa.

Extending from lower Pa to Da of mid octave only.

Mecha Kalyani Mela 65.

1. Kalyani. Same as Mecha Kalyani.
2. Saranga.

Ar. Sa Ri Ga ma Pa Da Ni Ṡa

Av. Sa Da, Pa ma Ri Ga Ma Ri Sa

Phrase Sa Ri Ga ma Pa is not permitted.

Really the raga runs usually as

Sa Ri Sa Pa ma Pa Da, Ni Ṡa

Ṡa Ni Da Pa ma Ri Ga Ma Ri, Sa

Note use of both Ma and ma.

Miscellaneous.

Janya in Mela 53 *Gamanasrama.*

1, Purvakalyani.

Ar. Sa ri Ga ma Pa Da Pa Sa

Av. Sa Ni Da Pa ma, Ga ri Sa

Special features i. Pa Da Ni, Da Pa Sa

ii. Pa Da Sa

iii. ma Da Sa

iv. ma Da Ni ri

Janya in Mela 17 (*Suryakānta*).

2. Sourashtra.

Ar. Sa ri Ga Ma Pa Da Ni Sa
Av. Sa Ni Da ni Da Pa Ma Ga Pa Ma Gri Sa

Ni Sa | in aroha is almost | Sa Sa | with a back ground of Ni

Janya in Mela 36.

3. Natai.

Ar. Sa Ga Ma Pa Ni Sa
Av. Sa Ni Pa Ma (Ri,) Sa.

Janya in Mela 14 *Vakulābharana*.

4. Ahiri.

Ar. Sa ri Sa Ma Ga Ma Pa da ni Ṡa

Av. Ṡa ni da, Pa Ma Ga Ma ri, Sa

The elongated da is characteristic, and Ma Ga ri Sa is permitted.

As a matter of statistics I tabulated the number kritis (and kirtanas) etc. of Thiagaraja in a printed book containing only the words of the melody to ascertain what ragas the great saint and composer delighted in, as an indication of their aesthetic beauty.

The largest compositions known by the name 'Pancha Ratnas' or the Five Gems are in Gaula, Nata, Sri Raga, Arabhi, and (Jhala?) Varali. Out of the total of over 650 melodies enumerated, the five ragas, Sankarabharana Hanumatodi, Sourashtra, Saveri, and Kalyani carry the palm, each having over 20 compositions.

Next come the 14 ragas, Bhairavi, Madhyamavati Arabhi, Yadukulakambodhi, Punnagavarali, Aṭana, Devagandhari, Kharaharapriya, Ritigaula, Kedaragaula, Begaḍa, Bilahari, Sahana and Mohana, with ten compositions or over in each. Next in order come the 11 ragas Kambodhi, Harikambodhi, Asaveri, Dhanyasi, Saranga, Mukhari, Darbar, Suddhasaveri, Nilambari, Ahiri and Surati, with over five compositions in each. So much confusion exists today regarding ragas Subha Pantu Varali, alias Varali, Jhala Varali, and Kama Vardhini, alias Pantu Varali, that I have not had them separately listed. Every South Indian with any claim to a decent musical education or knowledge, knows and delights at least in the raga Bhava of these thirty-five or more ragas.

CHAPTER XIII.

OBSERVATIONS.

Staff notation:—

I should think that every Indian, who is true to the genius of Indian Music will resist this attempt, to write music in staff notation. We have a sufficiently reliable method of writing music correct to the 12 swaras or the 12 rough pitches in the octave both in relation to time measure and the particular swaras entering the music. The more capable student, when once the raga bhava is known, is able correctly to sing the melody after some effort, understanding the present day notation, which is just the skeleton framework, and the sense of natural intonation fills in that framework. It may take some years

of musical study to understand the raga *bhava*, but that is no reason why we should go in for a staff notation, which does not carry an *auditory* impression, also at the same time. As I have said, the swaras Sa Ri Ga Ma Pa Da Ni with flats and sharps, when sung and understood, convey both a *visual and an auditory* impression with a texture of spoken words, and it is an evil day when we shall choose to reject this method, which has led to development of melodic music and stood the test for over two thousand years.

General Remarks about Violin and Vina Play.

A question may be asked "How is the correspondence between the vocal music and the music on the instruments produced, and how is the effect of the pronunciation of the words brought into play?" Though this may be stated to be generally by gamakas so far as the intonation and grace are concerned, the consonants appearing in the melody are indicated by a change in the direction of the bow of the violin, and by a fresh plucking of the playing strings on the Vina. This makes it unnecessary in the writing of our music for any signs as to when the direction of the bow changes. The word of the melody, that is the consonant with its vowel ending, will just appear under the corresponding swara.

A word also about presentday vocal music. I have generally noticed, even among the better class of musicians, that the intonation of the vowel sounds is *not* quite correct. The Sanskritic 'ah' is like 'father' or 'calm' or as राम Rāma, both as long and short; but unfortu-

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nately a sound like 'cat' is coming into operation. The latter sound of a in the word 'cat' is not at all observable in any Indian language, and is very strongly deprecated in music. Also in the swara singing or *thanams*, it is correct to restrict ourselves to the 'ah' sound in father, as it is the most resonant vowel. Odd examples of 'oh' and 'eh' being used, for instance, in *regular raga alapana* are deprecated. As regards Vina play, there is a tendency to have more pluckings of the played strings than necessary. The prolongation of vowel sounds must be induced by simple pressure, by the fingers of the left hand across the frets, and fresh plucking would spoil the beauty of gamakas. Yet among the musicians of Mysore and the Andhra province, an enormous amount of plucking of the played strings is noticeable, which is not consonant with the traditions of Tanjore music, especially as regards the musical compositions of Kritis.

As I have already said, it is where the consonant of the word of the melody appears, that the fresh plucking of the vina string or the change of the direction of the bow ought to take place, and *nowhere* else as far as possible. The stresses and strains of rhythm may be produced by the violin bow in the prolongation of vowel sounds as occasion may require, perhaps more easily than on the vina itself.

It will not be out of place here if I mention some characteristics which I have observed in regard to sahitya or the words of a good melody. It is needless to comment on the subject matter, *i.e.*, the meaning of the words, as they should convey some lofty ideal or breathe

adoration. I should refer only to the purely linguistic phase of it. That melodic music has the greatest aesthetic value in which the consonants are mostly *soft* consonants and semi vowels largely occur. Conjunct consonants should be absent as far as possible, and if at all they occur, they should be syllables like 'tma', 'nya', 'dma' 'tya' 'nta' 'mma' 'nna' 'nja' 'sma' 'nda' and such others. And further each monosyllable must have a vowel ending and the word itself have a vowel ending. The Telugu of South India satisfies these conditions, best to my knowledge, among Indian languages, and this is probably the reason why Tamil composers even chose Telugu as the vehicle of their music in recent years. Sanskrit also is occasionally capable of such phraseology and some of the songs of Jayadeva satisfy the above conditions, and that is why they have not been lost, though their original notation has not been preserved to us.

Another feature of melodic music I should mention. It should take the intonation of common spoken language, and the vowel sounds should not be elongated very much at one pitch; for a single note is certainly no music, and the elongation possible should be the period of time in which the voice can take some rest. Nor should the music be so fast, as the present tendency seems to be, lest the human touch should be lost. Probably stringed instruments and their technique are responsible for such fast music, but this tendency to play very fast melodic music should be curbed. Again, the vocalist to-day in singing his classical compositions barely

understands the meaning of the song and the emotional effect of the song is lost upon us; for I am sorry to say that the high and lofty faith, which inspired the composers, is woefully lacking in the singers, and therefore an effort should be made by them to understand the words of the song.

In recent years, Karnatic music has come in for a lot of criticism by Hindustani musicians. (1) It is highly intellectual in character. (2) It is highly mechanical. (3) As a matter of mathematical computation, it tries to achieve the aesthetically impossible task of obtaining a large number of ragas. (4) It does not base its raga system on the *vadi* and *samvadi* arrangement, as understood in Hindustani music.

Against all this criticism, I would just cite only one instance in the history of Karnatic music. The raga Karaharapriya, with the swaras Sa Ri ga Ma Pa Da ni Sa, in both arōha and avarōha was not sung, and no compositions in that raga were available before the time of Thiagaraja. The ancient (Karnatic) Bhairavi true, took Da occasionally, but mostly used da in its melodic effort, and it is due to the genius of Thiagaraja that Kharaharapriya has become largely prevalent in South India. Though I am just a novice in Hindustani music, I have perceived by comparison, say, of Sriranjani of South Indian music with Bageswari of Northern India, the swaras being Sa Ri ga Ma Da ni Sa in both cases, the difference in technique is understandable, and the South Indian raga is richer in its variations of the six selected swaras (as panchama is absent). Similarly,

comparing Abheri, a raga of South India, with Bhimpalasi of Northern India, there is difference in the method of approach, both having Sa ga Ma Pa ni Sa in Aroha and Sa ni Da Pa Ma ga Ri Sa in avaroha. The difference is largely due to the small variations, as I perceive, in the microtonal changes of the swaras in the ascent and descent. Similarly as regards ragas Bhairavi of Northern India and Thodi of South India, or Bhoop of Northern India and Mohana of South India, or Tilang of Northern India and Natai of South India, and several others.

The Northern Indian musician may be aware of the 22 srutis in the octave but he has not attempted to use them in his ragas to a very large extent in regard to the selected swaras as I diagnose the case. This feature is seemingly responsible for the feeling of monotony, that the South Indian feels in listening to Hindustani ragas.

In fact, I may say that the vocal Hindustani music, where it has not been vitiated by the advent of the harmonium, has received the impress of the mechanical possibilities of their instrument Sarangi. (This is really an inverted violin played upside down, but against the finger nails themselves. Though it has 24 to 30 resonating strings to create the intonation of the human voice, it has only strings tuned to 12 different pitches in the octave.) Similarly the vocal music of South India has been following the mechanical possibilities of the vina. Hence the tensions and the pulls in South Indian music, which are more expressive of all types of human intonation.

Speaking of vadi and samvadi, that is a relation of the true fifth or fourth, pupils of Vishnudigambar (an eclectic musical mind) have now taken up singing the Simhendramadhyama, observing the South Indian scale (Sa Ri ga ma Pa da Ni Sa). But the Hindustani will find fault with Shanmukapriya Sa Ri ga ma Pa da ni Sa, simply because ma and ni have not the relation of the fifth; but we South Indians know the latter as a very decent raga.

Of course, as has been truly said, "Music has its light moments, its charlatans and its academics"; hence South Indian music should not be judged merely by the fact that many exponents in vocal music do not come up to the high standard of true musical sounds, so far as they go, of several reputed Hindustani musicians who have visited South India, since the curvature and graces are more difficult in the Karnatic art. But the vina and the violin are certainly played quite true in South India.

One may certainly say that Karnatic music is highly intellectual and has less appeal to emotion, but this carries no discredit in my opinion. When Shelley has written a "Hymn to Intellectual Beauty", it is quite justifiable that aesthetic beauty can be understood by means of the intellect, and not alone through emotion, just as virtue itself has been taught as an intellectual concept by Socrates, though felt as a pure emotion by Jesus.

CHAPTER XIV.

MUSIC, EMOTION AND AESTHETICS RAGA AND RASA*.

Music is my hobby and so I propose to speak to you to-day on this subject. There is a saying 'One can ride a hobby horse to death'—but I do hope that before the end of my talk I shall be able to communicate to you some of the joy and happiness which I derive from the hobby of music; I can demonstrate on the violin if I am allowed, and affect you too. Musical talent, if I may frighten you with a big word, is a Mathematico-sex complex: but you all know Shakespeare's famous passage in "The Merchant of Venice"—"the man that has no music in him and is not moved by the concord of sweet sound is fit for treason etc., and that no man should trust him." Sure enough, the audience before me is not of the kind Shakespeare referred to.

You are all aware that music moves us, and we do not know why—we feel the tears, but cannot trace their source. It is said of the Greek Orpheus, and of the Hindu Narada that they, by the music of their instruments, the lyre and the vina, "drew trees, stones and floods"; aye, "Music hath charms to soothe the savage beast, to soften rocks, and to bend the knotted oak." The Sanskrit proverb, you know is—"that the cow is drawn by music, the child is lulled by it, the serpent feels it, and the man, who does not feel the power of music is only an animal without a tail".

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* Lecture delivered in Bombay on 30-11-35.

You may recollect also Shakespeare's opening lines in "The Twelfth Night". 'If music be the food of love, play on.' We also resort to music when we are in the grip of deep grief, when our heart is wounded, and our mind oppressed, for we know music helps to relieve us of our grief and to forget; and we ask ourselves the question "Why should music affect us?"

Nay, by the best Indian melodies, we are led to a glimpse of the Infinite, and to gaze upon it. The highest melodic music of India has always been what we call sacred, tending us to spirituality, when no more of our earthly burdens and trammels are felt, and we are lifted to a higher sphere of consciousness and the feeling of the Divinity within us: I make bold to say that where 'priests have failed in their mission', musician artists like Thiagaraja and Dikshatar have taken their place. It seems to wash away, from our hearts, the dust of every day life. One may contend that in vocal music, the meaning of the words affects man; but why should music through stringed instruments, reproducing the nuances of the human voice, just like primeval speech, akin to that before man ever learned or spoke any language, affect us? Can we offer any explanation?

The Sanskrit Aesthetic critics have defined, for the dramatic art, nine Rasas (emotions). Two more Rasas have been added later, and I add to these one more "Ananda" or Joy. Bhakti Rasa to my mind (devotional spirit) is not a simple emotion.

The emotions are:

1.	Sringara - Love.	2.	Hasya - Laughter.
3.	Karuna - Pity.	4.	Çoka - Grief.
5.	Raudra - Anger.	6.	Veera - Heroism.
7.	Bhayanaka - Fear.	8.	Bhibhathsa - Terrorising look.
9.	Adbhuta - Wonder.	10.	Çanta - Peace.
11.	Vatsalya - Tenderness as towards a child.	12.	Ananda - Joy.

Music embraces these Rasas, and awakens in us these emotions. The melodies of India have certainly been able to induce in us these emotions, though not all to the same extent. Nay, further, Nature's moods, such as the freshness of the dawn, the soft fall and calm of sunset, the moods which carry peace and joy unto the soul, have been embodied in our melodic music.

Addison says "Music is the only sensual gratification, which mankind may indulge to excess without injury to their morals or Religion." I am not so very sure of this dictum. A feeling of love, (sringara) may be awakened in us by music, and one has to be careful that it does not deteriorate to eroticism; and highly erotic music in excess would injure moral feeling. In fact, music of the lower sort is fire to play with, as we know it of late, in the decrepit Moghul, and other Princes' Courts in India. As for martial music, it is but an instrument of the devil, not at all consistent with the soul of a world humanity.

The recent South Indian melodies of the three great composers, Thiagaraja, Dikshatar and Syama Sastri of the late 18th and the first half of the 19th centuries in the Tamil land, have, more or less, Bhakti, or faith, as their subject matter. In their hands, the spirit of Contemplation or Peace of Soul is induced—as I have already alluded to, and the calm or peaceful mood is dominant. Indian melodists have all had conceptions of Ragas from the very beginning of Indian Musical History, and in the present day evolved music of India, and especially of South India, Raga and its Bhava are supreme in their concepts. Can we recognize that any particular Ragas have any definite emotions, and can they create the feeling of one of the several Rasas referred to?

As a practical artist, I feel I can associate the emotions arising in me though the power of pure sound in raga alapana, with the particular arrangement of swaras of the ascending and descending notes. For instance, in Nilambari, Nadanamakriya and Mukhari, one does certainly feel the emotion of grief, and it is as well that the theme of these ragas be also of profound grief so as to assimilate the sahitya (language) and the emotion. Sringara (erotic aspect of love) is more represented in the Hindustani 'khamas' rather than in our own raga khamas, which differs from the former only in respect of an accidental higher Nishada absent in the latter.

Vatsalya (tenderness as towards a child) is depicted to my mind in Ananda Bhairavi, Yadukula Kambodi, Madhyamavati, and Sriraga of South India; whether it is so, by the association of lullabies heard in child-

hood I cannot say. But those impressions last long. In Kalyani, especially when sung towards evening, I seem to feel the oncoming of the twilight and the shooting up of the stars. And as a hush comes over nature with darkness, there arises a restfulness in my consciousness. In Kambodhi, especially in the Trisruti Dhaivata, as I elaborate the raga round about it, I feel a sense of peace pouring into my soul. In the Thodi of South India, there is that vague tenderness, which is not associated with grief or parental feeling.

In Sankarabharana, though in some pieces like *Elagudayavatsuno*, there is pervasive self-pity combined with adoration, it should be possible for a composer to create in this raga, with a stress upon the antaragandhara (the higher Gandhara which merges with 'Sa and Pa') a sense of 'joy in life', which can pervade the whole raga. To this feature of 'Ga' I attribute the vivacity of the European song in the Diatonic scale and it should be possible for us to compose songs in this raga to depict the joy of life and to enable us to find happiness in this world here and now.

In Saveri and in Bhupala (Janya in Maya malava Gaula) taking Antaragandhara, Suddha rishabha and Suddha dhaivata, (in South Indian nomenclature) I feel the freshness of dawn; they are particularly, physiologically if I may say, suitable for morning hour because the vikruti notes are just above or below the 'Sa, Pa and Ma' in these ragas. Thus 'Nada' or sound becomes the object of "Tapas" (austerity or concentration.)

The feeling which every different Raga induces is difficult to portray, and there has been an aesthetic development of ragas as distinguished from feeling or emotional content. To give a parallel from portraiture, the Japanese who is used to his Mongolian eye has his own conception of the beauty of woman, which may not be pleasing at first sight to an Indo-Aryan. Similarly, the Grecian face and nose are different from that of the Teutonic. So also the aesthetic beauty of different Ragas has come to stay in the land.—

The different tastes in the Indian mind were created firstly by the great idea of Venkatamakhi, who lived in the 17th century in South India, of the classification of Ragas into 72 scales, together with their derivative ragas, in which certain notes are left out in the ascent or the descent in each scale, and secondly by the genius of the nomenclature of the swaras, extant from the days of Panini who lived about the 4th century B.C. as |Sa, Ri, Ga, Ma, Pa, Dha Ni| the notes Sa and Pa being fixed in relation to the fundamental pitches, and the other five having a variation of sharp and flat, of course roughly speaking, by which means musical phrases themselves, in swara singing, got the texture of words.

It may be noticed that the mono syllabic words Sa Ri Ga Ma Pa Da Ni, that is the swaras, have all vowel endings and have only two such vowel endings, namely ā and ē (अ and इ) and that can be elongated as आ and ई, also to any extent of time measure wanted. One word more about the aesthetic beauty of melody. • In spite of all the restrictions, which are placed in respect of the

particular swaras, roughly speaking, which may enter into the composition of a melody or raga type, there is and can be noticed *a fluidity of outline.* Our music is highly and elaborately articulated. One feature, which perhaps pleases an instrumentalist, a player on the Vina and the Violin even more than an vocalist, is the flow of pure vowel sounds, containing only vowels of varying pitch. The totality of effect in linear representation is the feature of Indian ragas, and this perfect art, with a natural intonation, has an ease delighting both the layman and the expert. Finally, the most aesthetic experience in melodic music I shall now describe. It is called the *sruti guana.* It connotes a finer perception than the *swara guana,* or the knowledge of deciphering music by the 12 rough pitches in the octave. It is beyond words to impart that perception, and one can feel it in the play itself. It comes on like a flood, if it comes at all, when maturity is reached; and in it, one feels one's most thrilling experience in melodic music.

CHAPTER XV.

MUSICAL METAPHOR—WHAT THE VIOLIN HAS TAUGHT ME.*

We often compare musical instruments with the human body describing the Saraswati-Vina as a Daru Vina—'Daru' meaning made of wood—and the human voice as a *Gatra* Vina, thereby giving the former a rank just below the human voice in its appeal.

The ancients do not, however, stop here. Imagining the vina inverted, the comparison is pushed further by the analogy of the vertebral column with the finger board of the vina, the twenty four frets of the latter being supposed to be similar to the separate pieces of the former. The two apertures on the face of the bigger gourd are said to correspond to the eyes of man, and the 'Yali' or the figure at the end to show the tail of the spinal column. It is here we feel the aptness of Johnson's remark that "comparisons are odious."

Yet, right through the ages, poets have fancied, in different musical instruments, the human characteristics. As a lover of the violin, a Western instrument, which has come into a vogue in India for the last century, the ideas which have found expression, either in common talk, or in literature, art and ethics about the music of the violin have interested me.

The violin player is sometimes the subject of derision and ridicule. Of one who has a dismal look, we say he

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* Originally written for "The Hindu" and reprinted with permission.

holds his face as long as a fiddle. We exclaim of a poor player, "My Lord, how he scrapes the violin!" Sometimes, we say in anger "fiddlesticks!", referring to any matter as worthless. These gibes at the violin, perhaps measure the despair and disappointment of its ordinary votary, who would seek to impress his audience long before he can get its mastery. Yet high class violin bows cost as much as a hundred rupees, and violins of good tone are worth a fortune.

This superb instrument has taught me to feel for it something akin to love. Shall I call the violin, she or it? With all apologies to the ladies, I shall use the feminine gender. Be rough to her, she yields no music; but coax her and forget your ego, she responds sweetly, as though she had a soul of her own. Honore De Balzac writing on the subject of love observes, "Woman is a delicious instrument of pleasure but it is necessary to know its quivering strings, study the pose of it, its timid keyboard, the changing and capricious fingering." He also says, "Man generally is as ignorant of love as an orang-outang of violin play." To Dryden, the poignancy of its appeal is apparent as to lovers.

"Sharp violins proclaim
Their jealous pangs and desperation
Fury, frantic indignation,
Depths of pain and heights of passion."

Then there is the pathetic spectacle of the violin player unable to soar to the desired height, described by Gustave Flaubert, writing on literary style:

"I am like a man whose ear is true, but who plays falsely on the violin; his fingers refuse to reproduce precisely those sounds of which he has the inward sense. Then tears come rolling down from the poor scraper's eyes and the bow falls from his hand."

Further, the pride of the musician, call it what you will, the pride of self-knowledge (Atmagnana) or the knowledge of God (Devagnana) is reflected in Browning's affirmation; "But God has a few of us whom He whispers in the ear; the rest may reason and welcome, it is we musicians know."

Shelley, the most psychical of poets, gives expression to the same thought, that great music can come only when there is deep feeling within.

"As music and splendour
Survives not the lamp and the lute,
The heart's echoes render
No song when their spirit is mute."

Tuning the Violin.

The tuning of this instrument, as done in South India, is different from the European style, the latter being by fifths—as *Sa Pa Ri Dha* or really Pa Ri Dha Ga. Even the tuning has taught me some valuable lessons in psychology. The psycho-physical parallelism, which regards the human entity as mind-body, has its counterpart in the concord. The "Sa", "Pa", of the lower octave being in unison with "Sa", "Pa", of the higher

octave, makes me appreciate and rightly understand the words of Browning:—

"Let us not always say

"Spite of this flesh to-day

I strove, made head, gained ground by on the whole

Let us cry "All good things are ours, nor soul helps flesh more, now, than flesh helps soul."

In this unison, the higher octave strings represent the more fleshly desires and passions of man, and the *mandara sthayi* strings are comparable to the *Manas* and *Buddhi* of man.

To one who has felt the appeal, there is neither convention or set technique in his art. Once when I was playing before an Indian violinist, an artist in a Military European band, who had not heard previously South Indian music, asked, as he heard my violin tuned, "What have you done to the violin that it is so beautiful? Then I realised that an Indian is in his heart of hearts only a melodist.

The violin has taught me the right use of leisure. The occupation of man in his leisure moments truly measures his culture. We in these modern days are prone to throw a coin over the counter, take a seat to hear either mechanised music, or other artists, and console ourselves that we have purchased happiness. But the essence of joy is accessible only to those who patiently withdraw themselves during leisure hours, inspired by true love of the art, in the true joy of the practising

artist, when they have attained some level of perfection in the art by their own unremitting effort. It is this peace and knowledge of eternal verities which our Rishis wanted us to cultivate so that it may permeate our daily lives and make us better fitted for the day to day work of this world—for "where the priest has failed in his mission, the artist musician like Thiagaraja fills that place."

The violin has also taught me some lessons in ethics. As melody can be played only on its tightened strings, kept in proper tune, it has taught me that in all human life, there is a moral tension, whose adaptation to evoke melody has made me realise the wholeness of life (and the resolving of conflicts), and of ceaseless activity in the world associated with the contemplation of the Divine Count Keyserling has expressed himself thus:—

"The fulfilment of that life, which is the life of free creative man is related to these problems (of human happiness and sorrow) which seem to contradict the idea of cosmic order ruled by the spirit of goodness and beauty, much in the same way, as the melody is related to the violin."

EPILOGUE.

When the major portion of the book was written, I came across a reference to my booklet with the title "A Note on the Srutis of Karnatic Music" published in 1929. The reference is found in the publication of the Madras University, "Ragas of Karnatic Music" (1938) by N. S. Ramachandran at p. 47, and reads as under.

"Mr. C. S. Iyer in his valuable pamphlet says that 3 more srutis should be welcome as additions to the 22 srutis (this resembles the view of Mr. Clements), and that the South Indian ear is even sensitive to as many as 30 srutis in all. The latter statement is important because it indicates the truth of the practice, and also because it questions the validity of the 22 srutis."

At the time of publishing the booklet in 1929, I was naturally drawn by my violin technique to the observation of the slight but definite changes in *pitch*, occurring in the 12 swaras, as ordinarily denominated, and *that they are not alike in all ragas.* This, I checked with the help of a long sonometer, taking great care that the tension of the string does not alter, by putting a wedge underneath, and reading off the lengths of the vibrating portions of the string. It is indeed a *crude* method, as after all a stretched string is a catenary though fairly tight, and helped by mathematical working, backwards and forwards from Sa Pa and Sa Ma I arrived at the

results of the 22 srutis, which are also taken to be true by Helmholtz in respect of the Persian and Arabian music. The Maya Malava Gaula raga, however, in which all first lessons in music are learnt in South India created some difficulties in regard to the frequencies. Then I postulated, as far as my ear could judge, by the sonometer, that the three notes 48/25, 24/25 and 25/16 are essential in our music, and these are the three additional notes which I suggested ought to exist. The corresponding ratio on Sa string 32/25, will also enter in Maya Malava Gaula raga. Then I thought that the small variation of 22 cents (81/80) from the *linaka* swaras, where the voice could stand, could perhaps justify the variations in our music, that is to say, the semi tone dropping to a 90 cents interval, the major tone dropping to a minor tone, and minor tone becoming a major tone as may be necessary and these changes should sufficiently explain our South Indian music. But the tests carried out by the tuning forks to a large extent deny the theory of srutis being pure gamakas from linaka swaras; because, at many of the 22 srutis, the voice does stand and elongate the swaras as I illustrated in the ratios 7/4, 7/6, 7/5, which do not figure however, in the ratios obtained on Sa Ma and Sa Pa bases.

I am unable, however, to agree with Mr. Ramachandran that the very complex frequency ratios (such as he observes at pages 50 and 206 of his book) can all occur in our music. The method of measuring frequency ratios by the sonometer is too inaccurate to say quite positively that they do exist, since certain mathe-

matical laws must prevail in the art of music. As I have already said elsewhere, "To attempt to describe an art is an illusion." I also attempted in 1934 to obtain sound photographs of violin curves from the Teddington Laboratory, London with the help of a Duddell oscillograph (a copy of the report is given just after this chapter). It is just annexed to show any future investigator the method which may be adopted for taking out curves in violin play for the study of srutis. The investigation of the sound photographs unfortunately gave results, true only to the first approximation, of the 12 swaras, because of the recalculation necessary at each stage with reference to standard, for the rotation of the drum to which the photographic plate was attached was not uniform during the experiment. It would involve indeed a very fine experimental technique to be able to measure the frequencies in our music with sufficient accuracy:

I do not say that the frequencies of the srutis mentioned at pages 72 and 73 have been determined scientifically, but they seem probable as suggested by my mathematical imagination, based on the evidence before me.

NATIONAL PHYSICAL LABORATORY, TEDDINGTON.

REPORT ON THE OSCILLOGRAPHIC RECORDING OF CERTAIN VIOLIN NOTES.

PHYSICS DEPARTMENT.

For: Mr. C. Subrahmanya, London.

Object of the work.

The object of the work was to obtain oscillograph records from which the pitch relations of certain notes and phrases, described as occurring in southern Indian music, might be determined.

Method of experiment.

The notes and phrases concerned were played by Mr. Subrahmanya on his violin. The sound from the violin was received by a condenser microphone distant about 2 ft. from the violin, and connected through a valve amplifier to one of the vibrators of a Duddell Oscillograph. The wave form of the sound was recorded on photographic paper by means of a revolving drum camera attached to the oscillograph. A time scale was provided on each record by a second vibrator which registered the wave form of the electrical output from a standard valve maintained tuning fork, operating at a frequency of 1000 cycles per second. The player and the receiving microphone were situated in a lagged cabinet so as to avoid as far as possible, any interference from extraneous noise. Communication between the player and the operator of the recording apparatus was maintained by a system of visual signals, controlled by the mechanism of the shutter on the recording camera, the player being warned one second in advance of the opening of the shutter and also at the commencement and conclusion of the exposure. The duration of the exposure was approximately one second in each case.

Description of records.

In all, seventeen records* were made, the description of the phrases provided by Mr. Subrahmanya being as shown in the table below.

Description of records.

Record No.	Description of phrase.
1	Open first string (steel).
2	Surati Ni (First note on record).
3	Malava Gaula Ga. (Last note on record).
4	Madhyamavati Ri. (Wavering portion of record).
5	Begada Da. (Middle note of phrase).
6	Ananda Bhairavi Ga. (Steady note).
7	Saveri Ri.
8	Saveri Da. (Wavering note. Middle note of phrase. Phrase probably repeated twice).
9	Kalyani Ga. (Wavering note).
10	Open first string (steel).
11	Open first string (steel).
12	Begada Da. (Repeat of 5).
13	Saveri Ri. (Repeat of 7).
14	Kalyani Ga. (Repeat of 9).
15	Thodi Ga.
16	Thodi Ni.
17	Open first string (steel).

The records, numbered and described as in the above Table, are appended to this report. Each record is mounted so that it begins at the left hand end, the

* Each 50 centimetres long C.S.

upper trace being the time scale and the lower the record of the violin note.

The records were taken in two groups, numbers 1 to 10 and numbers 11 to 17, separated by a short interval of time. The violin was retuned immediately before the second group of records was taken. The first and last record in each group show the wave form of the tone on the open string, thus enabling any variation in the pitch of the string during the experiments to be detected. Three records in the first group, Nos. 5, 7 and 9 were repeated (Nos. 12, 13 and 14) since there was some doubt as to whether the correct portion of the phrase had been played during the exposure. Record No. 7 was defective also on account of some extraneous disturbance which had produced violent distortion in several places on the record.

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Director.

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ERRATA

Page	Line	For	Read
25	3	493	498
31	12	the frequencies	the twin frequencies
32	1	Raghabhava	Raga bhava
32	10	or	on
36	28	weebit	wee bit
37	5 and 7	Do	Do
40	6	major	minor
44	6	6/5 or 4/3	6/5 or 5/4 or 4/3
65	15	im ta ne pa	im ta ne ba
75	22	sa ma	Sa Ma
76	Last	scent	ascent
94	6, 7 and 8	3 Ma	3 Ma mo
95	7 and 8	3 da Pa	3 da, Pa,
98	4	14. Bakulabharana	14. Vakulabharana
100	14	39. Jala Varali	39. Jhala Varali
101	13	know	knows
107	Last	alike	like
108	5 (item 12)	|Sa Ma Pa ni Da Ṡa|	|Sa Ma Pa Da ni Da Ṡa|
117	12	Northern	North
123	26	for morning	for the morning
129	14	or	nor
wherever occurs the word kaisika			kaisiki
47	12	Chatuh Chatuh	Chatuh Chatuh Chatuh
77	2	5/8	5/3

NR2
N3

3, **A "Music lover"** and teacher writes:

* * *

"The book has a personal appeal in it throughout. The clear and simple manner in which the author has dealt with the subject, the references to his own experiences, the numerous interesting and apt examples of principal shades and srutis cited from ragas, with lucid illustrations of svara phrases in which they occur and the masterly way in which the author has gripped the salient features of some of the apurva ragas make one deeply interested in the book. * * * It will be of great use to teachers and students of Indian Music."

4. **Mr. M. S. Ramaswami Ayyar**, some time Research Fellow in Indian Music, the University of Madras, writes:

* * *

"Mr. C. S. Ayyar's grammar is an interesting, instructive and even inspiring treatise. * * Whole-heartedly do I recommend the book to all music lovers here and elsewhere."

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The Indian Music Publishing House,

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